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November, 1960

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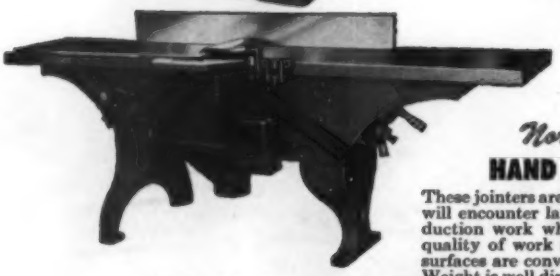

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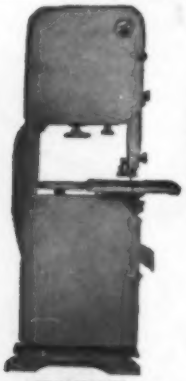

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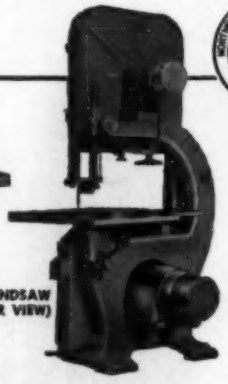

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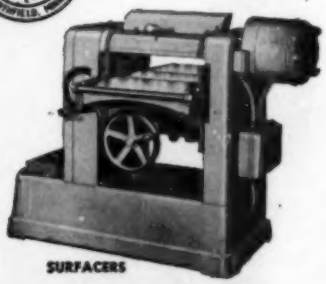

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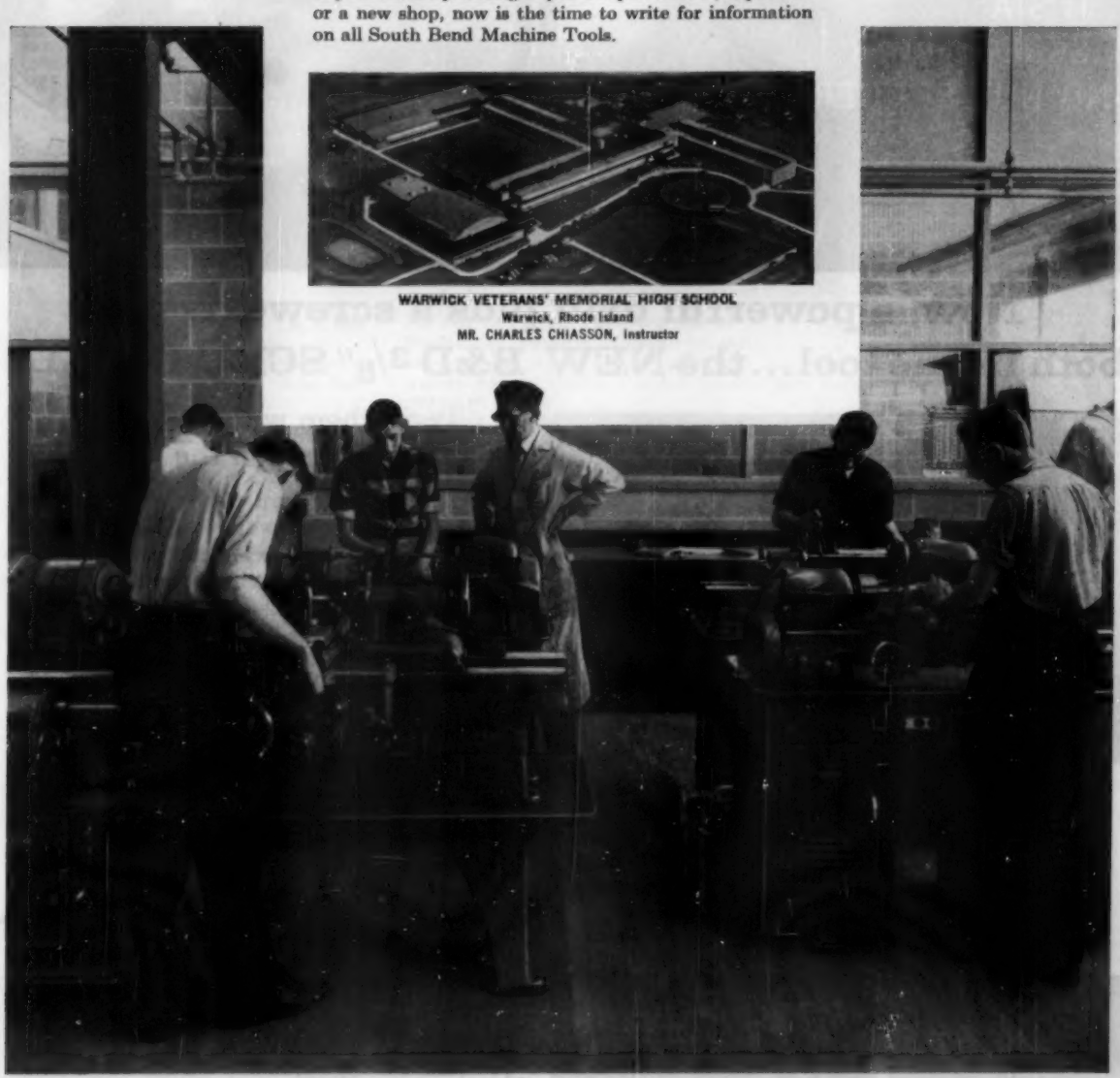

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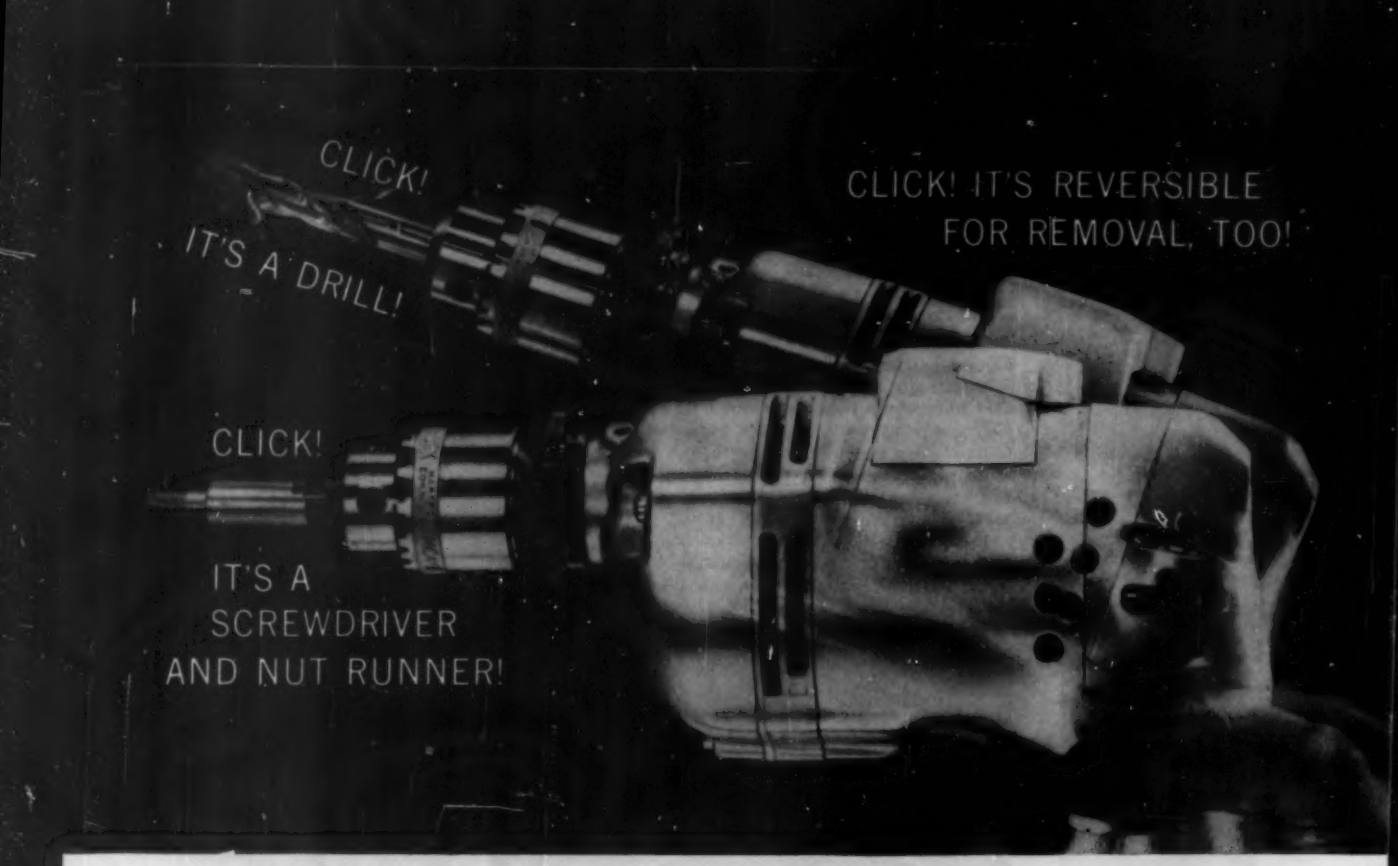


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Vol. 49, No. 9 / November, 1960



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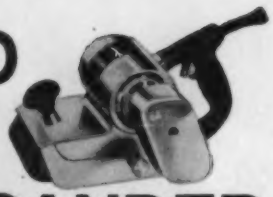

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## your IA/VE for November

While Navy engineers, college professors, and other authorities on what we should teach the boys and girls in our high schools cry out for **college preparatory "solids" for all students our country's shortage of skilled craftsmen grows more critical.**

Your IA/VE for November focuses a spotlight on this serious problem — which is predicted to increase during the next 20 years — by discussing (pg. 18) **the nature of the situation and what is being and should be done to reverse the trend** in the technological years ahead.

Other features which we believe you'll find of interest include:

1. The second article (pg. 42) in our series, **profiles in industry.** It's all about **the field of plastics,** created and fostered into one of the most important areas of modern American industry by the wonder of research.

2. And since research is so vital to industrial growth, we should use **a research-experimentation approach to meet one of three challenges of industry.** As a ramification of the problem-solving technique, this approach — described with typical working outlines, problems, solutions, etc. (pg. 23) — provides a student-teacher team arrangement.

3. **Encouraging creativity** in students is one of the prime responsibilities of a teacher and our consideration of this duty (pg. 20) has **a battery of realistic suggestions** on how to accomplish this goal.

In addition, we hope you'll have a chance to look over the other **half-dozen general articles** in this issue, as well as the **eight project ideas** in wood (pg. 32), metal (pg. 29), plastic (pg. 30), electricity-electronics (pg. 39), etc.

And please don't forget the **regular departments** — especially the **"opinion" column** (pg. 12) **which reports what industrial educators believe about the place of industrial arts and how well-defined its nature and scope are.**

## for December . . .

**December is AVA convention** time and your IA/VE for this month will feature **a preview of the meetings.**

*the editors*



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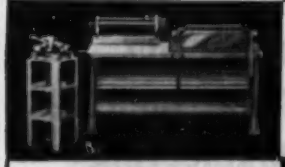

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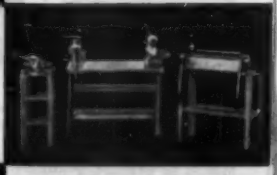

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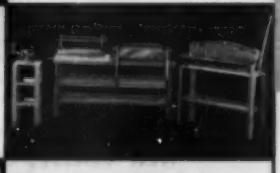

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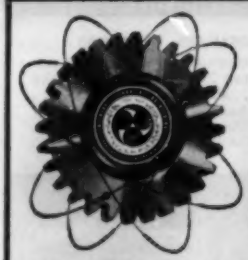

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## MISSISSIPPI VALLEY MEETING

The 47th meeting of the Industrial Arts Conference will be held on November 10–12 at Chicago's Hotel LaSalle under the general chairmanship of Dr. Verne C. Fryklund, president, Stout State College, Menomonie, Wis.

The five discussion sessions planned for the program include:

1. "Changes in Content in Industrial Arts to Meet the Needs of a Technological Age" (chaired by Ray Karnes, University of Illinois, Urbana).
2. "Life, Education, and Work in Russia" (chaired by H. H. London, University of Missouri, Columbia).
3. "What Are the Functions of Professional Associations Such as AIAA, AVA, NAITE, and State Associations" (chaired by I. W. Prakken, Ann Arbor, Mich.).
4. "Master's Degree Program for Industrial Arts Majors: Its Nature, Purpose, Breadth, Depth, Etc." (chaired by Ralph O. Gallington, Southern Illinois University, Carbondale).
5. "Recent Research in Industrial Arts" (chaired by Ralph Wenrich, University of Michigan, Ann Arbor).

## JOINT I-A AND V-E CONFERENCE

Industrial arts and vocational education teachers met on the campus of the State University of New York College for Teachers, at Buffalo, N. Y., on October 21, to conduct their one-day conference on "Guidance and the Teacher." Speakers included Dr. Gerald B. Leighbody, deputy superintendent of schools, Buffalo; Harold L. Munson, Guidance Department, University of Rochester; and Charles B. Odell, director, Older and Retired Workers Department, United Auto Workers of America, Detroit.

## NATIONAL ELECTRONICS CONFERENCE

The Sixteenth Annual National Electronics Conference and Exhibition was conducted on October 10 to 12 at Hotel Sherman, Chicago, Ill. This conference is sponsored by the American Institute of Electrical Engineers, Illinois Institute of Technology, Institute of Radio Engineers, Northwestern University, and the University of Illinois.

More than 250 leading electronic firms displayed their latest products, and over 10,000 engineers, scientists, management executives, students and educators viewed the 275 U. S. and foreign commercial exhibits.

Approximately 100 technical papers were presented during the three day conference covering such technical areas as the following: computer circuitry, digital computer applications, digital data transmission, feedback control systems, magnetohydrodynamics, microelectronics, etc. Some of the principal speakers were: James D. McClean, president, Stromberg-Carlson Company, Rochester, N. Y.; Dr. Frederick E. Terman, provost, Stanford University; Vice-Admiral John T. Hayward, deputy chief of Naval Operations (Development); Dr. Charles Kimball, president, Midwest Research Institute, Kansas City, Mo.; Brig. Gen. B. G. Holzman, commanding general Air Force Research Division; R. W. Olson, vice-president, Research and Engineering, Texas Instruments, Inc., Dallas, Tex.

## 1960 LEADERSHIP CONFERENCE

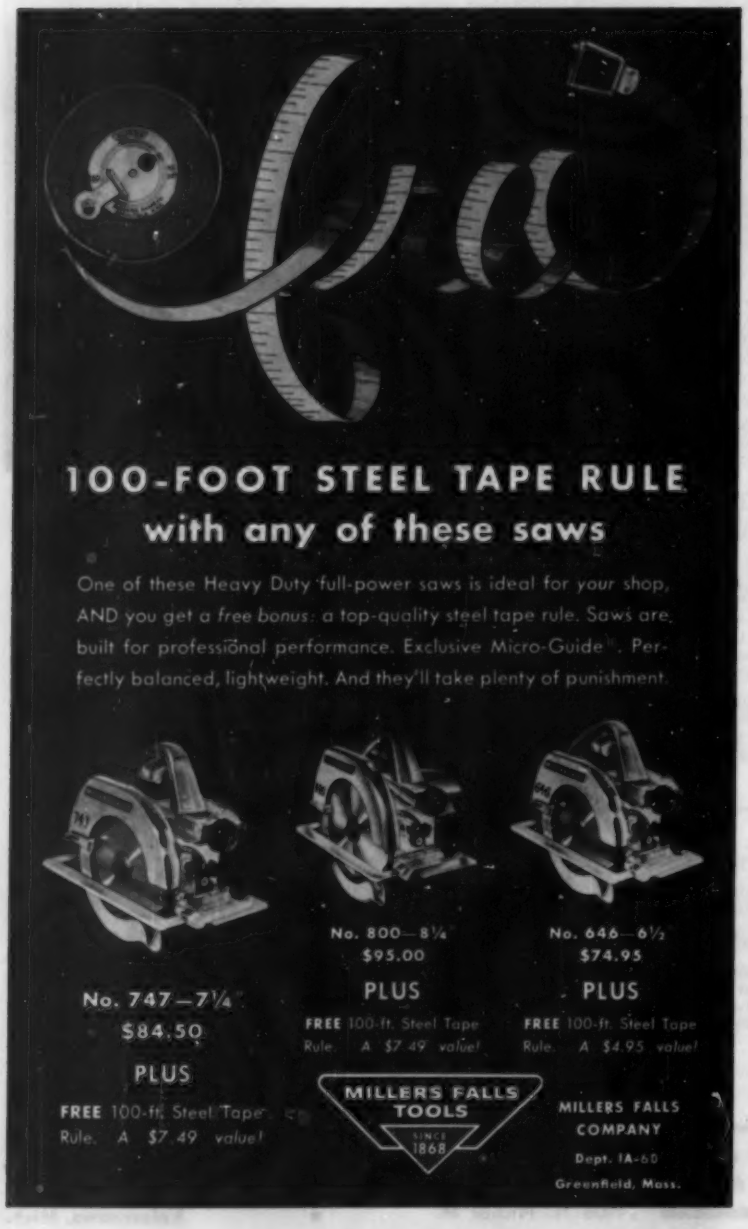
The 1960 Leadership Development Conference — Southern Section, of the California Industrial Education Association was held at the Orange Coast College, Costa Mesa, California, on Saturday, May 21, 1960, with Ralph R. Demmler of Los Angeles City Schools acting as chairman.

The keynote address was "A Challenge to Leadership" delivered by Dr. T. Stanley Warburton, Associate Superintendent, Los Angeles Division of Extension and Higher Education.

The purpose of the conference was to furnish both inspiration and information to new officers and to provide the C.I.E.A. officers with an opportunity to observe and participate in discussions and study of problems of industrial education organization and its program to the end that the abilities and skills of leadership will be strengthened; to provide opportunities for planning; to promote professional growth of the ranks of industrial educators; and to provide them with information of the latest trends in supervising and administering industrial education programs, especially as it relates to the Industrial Education Association.

Dr. Warburton stressed the fact that we needed better communications within our organization and that it was up to the leaders, such as were represented here, to know where you have been and where you are going. Toward this end he displayed a compass which served as a symbol of the future. He stated that all people need symbols of leadership and confidence in the past as represented by the totem pole doll — Indian symbol for the past, and their confidence and ability to survive with meager resources, and to obtain new courage. "We, today, can do it even better."

(Concluded on page 48)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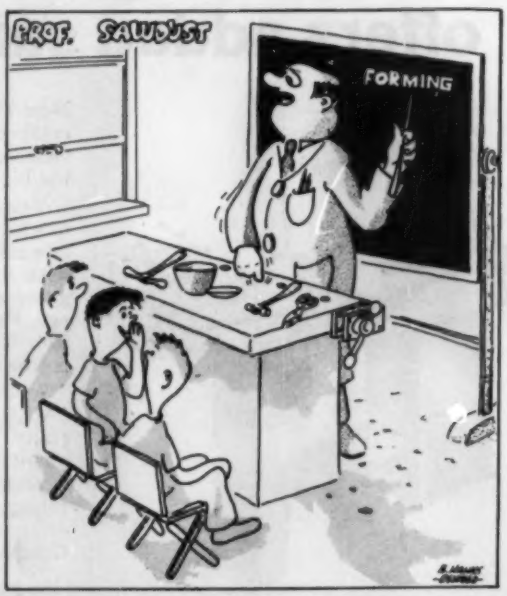
# news

**good year for voc ed** The 1960 legislative year has been another reasonably successful one for vocational education. Congress has appropriated the largest sum (almost $49 million) ever in a peace time year and ignored a $2 million budget-cut recommendation by President Eisenhower.

**Title VIII program funds** A report on Title VIII program funds by the Commissioner of Education to Chief State School Officers throughout the country prepared by the Area Vocational Education Branch of the U. S. Office of Education is included in the report of the 1960 National Conference of State Supervisors of Title VIII programs (bulletin OE-80011). In the 1959 fiscal year, the report stated, $3.75 million in federal funds was appropriated, a figure which almost doubled in the 1960 fiscal year. A $9 million appropriation is slated for the 1961 fiscal year. Two types of training programs in the states are being set up: preparatory and extension. About 60 per cent of total enrollment is in extension courses. The report said that 262 programs were carried on by various types of institutions, the most in vocational or trade schools (86) and comprehensive high schools (73). Others included community or junior colleges (38), Area Vocational-Technical schools (17), technical high schools (14), four-year colleges or universities (10), and state boards for vocational education and others (24).

**pioneer programs for drop-outs** The New York City schools last September initiated the first of three pioneer programs to help high school students who drop out before graduation. Experiment No. 1 saw the enrollment of 400 16-year-old students in the city's first evening continuation classes. Substitution of evening classes was approved by the state legislature last spring, when it repealed the 40-year-old requirement that dropouts must attend half-day-a-week day continuation classes until they reach the age of 17. Pupils selected for the night school program had shown interest in continuing their education and had school records indicating a likelihood of success in the evening program. A minimum of two courses is required in the evening school, selected with the approval of guidance personnel. The second experiment is an intensive six-week, pre-employment course aimed at keeping dropouts in school until they have found a job. The third experiment entails a 50-50 work-school program, intended to convince dropouts to complete their high school education.

(Concluded on page 67)




"We're in for another long demonstration. His finger is stuck in the bench stop hole again."

# STANLEY SHOP TALK

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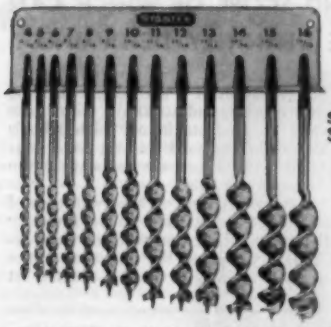

Stanley Russell Jennings Bits
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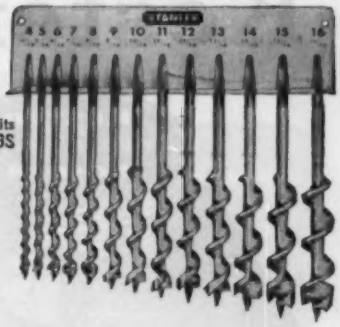

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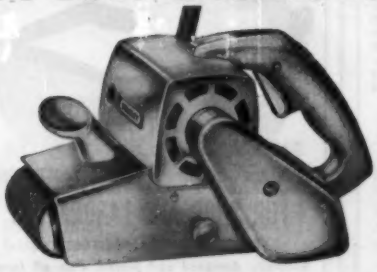

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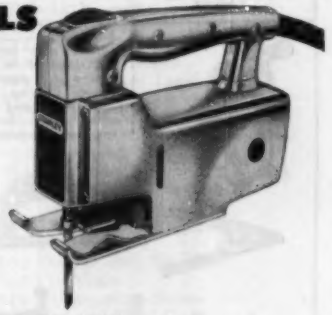

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# opinion

## DOES INDUSTRIAL ARTS HAVE A WELL-DEFINED PURPOSE IN EDUCATION, THE NATURE AND SCOPE OF WHICH CAN BE DEFINITELY DETERMINED?

The realization of a need for re-defining and restructuring industrial arts to increase its value to students in our high schools by leaders in the field has led to a concentrated analysis of the present nature and scope of the field.

To achieve an idea of how well-defined industrial arts is believed to be presently by those supervising and teaching the subject today, we asked the above questions of a list of IA/VE readers selected at random. The response was a strong 76 per cent affirmative.

**Does industrial arts have a well-defined purpose in education, the nature and scope of which can be definitely determined?**

Yes 76% No 24%

Answering yes, a large city industrial arts supervisor believed that the purpose of industrial arts is well defined: "It is general technical education, using tools and machines in manipulative work as one of its principal methods of learning-teaching." . . . Industrial arts, to me, is a study of *industry*, and is of the same value to all students as any other "discipline" in the "liberal arts" or human "humanities." A teacher replied with an emphatic "Yes, it always has and always will have a well-defined purpose in education." Another asked, "When approximately 70 per cent of our people will be working in industry, where else will students get some experience that will help adjust to an industrial situation?"

One supervisor qualified his affirmative reply by stating that the question deserved "A strong yes to the first part . . . but the latter part of the question would in my mind be answered no. A teacher believed that the purpose is better defined now "than 10 years ago."

Answering negatively, one teacher stated that "There is a lack of agreement among our so-called leaders as to what the scope and sequence should be." Another: "Every one seems to be headed in a different direction. There are too many philosophies and not enough good common horse sense!"

Qualifying a negative response, a supervisor from the Midwest replied that "I don't believe there is a *well-defined* purpose of industrial arts in education. I'm not sure it can be a precise statement, because the industrial arts program *must* be so varied and flexible so that they (courses) will meet the needs of individuals in various localities."

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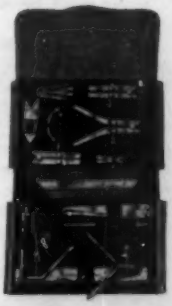

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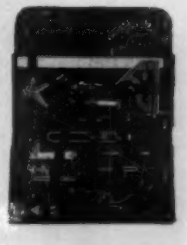

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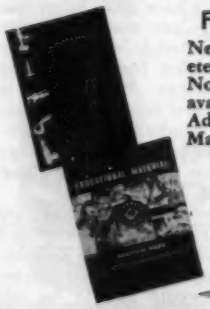

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## INFORMATION ON THE OCCUPATION OF DENTISTRY

During World War II, your editor served as an educational officer in a Navy school that specialized in the training of aviation mechanics. The Naval base was located very near one of the large Naval hospitals. It was during that time that acquaintance was made with a medical officer who specialized in oral surgery. It was a point of special interest to find that this officer had one big thing in common with industrial education people, namely, an interest in metalworking.

This medical officer had been trained as a dentist specialized in surgery on the mouths and jaws of wounded Navy men. As the war went on, the operations grew in number and complexity. The medical officer found that he lacked much of the equipment for certain specialized phases of the operations. He was also faced with a lack of known devices for holding the mouth and jaws in place after an operation was performed.

So it was that he came to our metal shops to work out strange and sometimes grotesque head frames that he could use in doing his unusual operations. As a matter of fact, for a period of at least two years, he spent almost as much time at our metalsmith school as he did at the hospital. He was, of course, only one of the small number of specialists in dentistry who are capable of doing this type of oral surgery. There are only about 4 per cent of the approximate 100,000 dentists who specialize in such areas as oral surgery, as orthodontists (straightening of teeth), prosthodontists (making of artificial teeth), pedodontists (children's dentistry), and oral pathologists (diseases of the mouth).

It was this experience that brought the full realization that, to be a good dentist, one must also be a good metalworker. Have you ever really watched a dentist work? If so, you have noted his skillful and precise handling of a great many tools. He can file, drill, chip, cut, and use some form of all the basic tools you use in the metal shop. He cuts and forms metals, sharpens tools, and does a kind of miniature foundry work. He is adept at many other metalworking processes. He must be able to drill accurately, use clamps, make impressions, and handle an imposing array of metalworking tools. In his laboratory he uses grinders, buffers, and small foundry equipment.

### Characteristics

What are the characteristics of a good dentist?

1. He must like to work with tools.
2. He must be interested in the sciences and do well in academic courses.
3. He must enjoy working with and on people.
4. He must be willing to operate his own business.

Perhaps these are characteristics that you possess. If so, you might consider this excellent medical profession. In addition to using tools and equipment skillfully, a good dentist must possess excellent visual memory and judgment of space and shape. Above all, he must have a high degree of manual dexterity. In addition to locating and filling cavities and pulling teeth, the dentist also straightens crooked teeth, takes X rays, and treats gum diseases. He writes prescriptions, advises on diet, and even diagnoses oral disorders that may effect general health.

### Preparation

Preparation for the profession of dentistry requires, first of all, at least two and sometimes three years of predental study. Pre-dental education demands the ability to do advanced work in chemistry, biology, and physics. Next the prospective dentist spends four years in professional training. In dental colleges, both classroom and laboratory work is done in the basic sciences during the first two years. The last two years are spent gaining experience in actual work with patients. After graduation, most dentists establish their own offices. They must purchase their own equipment, build up their own office, practice and develop their own clientele.

The family dentist comprises about 96 per cent of the total group. The average dentist is a self-employed businessman who takes care of his own business records, arranges and pays for his own vacations, and provides for his own retirement along with all of the other phases of his business life. He usually requires the help of a dental technician, a dental assistant, nurse and/or office girl. The average dentist spends close to 46 hours a week on the job. Some dentists have office hours one or more evenings per week. He must arrange his own schedule in order to get away from the office for vacations or professional meetings. His income is small during the first few years of practice but grows rapidly after establishment in the community. The average family dentist has an income of about $12,500 per year.

In your industrial arts courses you can discover whether you are interested in working with precision tools and machines. If you are and also enjoy courses in science and would like to be self employed, then you should certainly consider the occupation of dentistry. — *J. L. F.*

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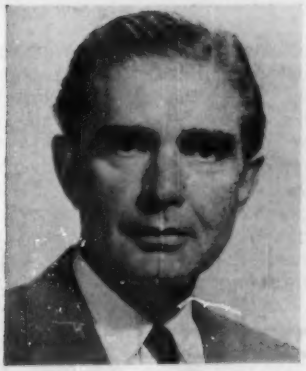


the editor's stand

# THE CASE FOR POWER MECHANICS

It would be redundant to suggest that we live in the age of power. We constantly read in newspapers and magazines of the feats that power has made possible. Land, sea, air, and space travel are all possible because of power.

When you visit the average junior high industrial arts shop, however, you don't know that power exists. As you walk into a shop you see a visual aid which shows the parts of the hand plane or a display board telling how to rivet sheet metal. But what about power? Is anything said about it in the industrial arts shop?

We say that industrial arts represents modern industry and our industrial society. Then why isn't there a unit and/or a course in power mechanics in every industrial arts department in the United States? Why aren't we keeping pace by including power mechanics? Why aren't we doing something to help students understand the power that makes our lives more comfortable, that does our work for us, and that gives us convenient, comfortable transportation?

We all know what has happened in our country during the last 100 years. Only 100 years ago, 5 per cent of the energy sources were mechanical, while human and animal power provided the other 95 per cent. Today, well over 98 per cent of all energy comes from mechanical power sources. With such blatant figures before us can we continue to deny the existence of power as an important part of industrial arts? Look for a moment at just one small phase of power — that used around the house and in recreation. Do you know that 94 million Americans have visited the immense reservoirs put up and maintained by the United States Corps of Engineers? This doesn't count the millions who spend leisure time on natural lakes and streams. A major reason for this interest is the outboard motor. The power lawnmower has changed the Saturday-morning drudgery of grass cutting to a brisk walk. Even golfing has taken to wheels with the power-operated golf cart.

The story of power is the story of America's industrial might. Each day we are learning more and more about how to harness fuel and energy sources for the production of useful power. We have come from the age of water power and steam engines to the age of jets, rockets, and missiles. Today the jet engine, the nuclear-powered electrical generating plant, and the solar battery are items of common interest to our teenage youth. Are we in industrial arts to continue to ignore all this? Can we really say that we represent the industrial world if we fail to include power?

Let's list some good reasons for recommending a unit or a course in power mechanics as a fundamental part of all junior or intermediate school industrial arts:

1. It is a good introduction to the service industries. The most rapidly growing occupational group in the United States includes the people in service industries who do maintenance and repair work on manufactured items. In power mechanics the student will learn to work on a manufactured product. He will learn how to disassemble it, test it, repair it, replace parts, reassemble it, and test it. He will be exploring a most fundamental occupational area.

2. It gives the student a chance to study about power. Students learn about the principal sources of power, when and how these were developed and what they are used for. They can trace the history of power from muscle through wind, water, combustion, and finally to the atom and sun. Students will learn by actually operating an internal combustion engine, by taking it apart and by seeing what is inside. They will learn the vocabulary of power and have a chance to see how power is produced.

3. It provides an opportunity to study other related occupational areas. Most power units are completely dependent on the products of the petroleum industry, for petroleum provides fuel to operate the power units and the lubricants for the mechanical parts. This industry alone employs over half a million workers.

4. It is an excellent tie between metalworking and electricity since all power mechanics units are basically metal and function through the use of an electrical system.

5. It will motivate students to study related science and social science. The teacher can tap the teen-age students' natural interest in power mowers, outboard motors, motor bikes, motor scooters, and other power units. These students want to learn more about these things — how to operate, maintain, and repair them. At the same time they can learn the applied science on which industry depends. They can learn the relationship between the science and technology of industry.

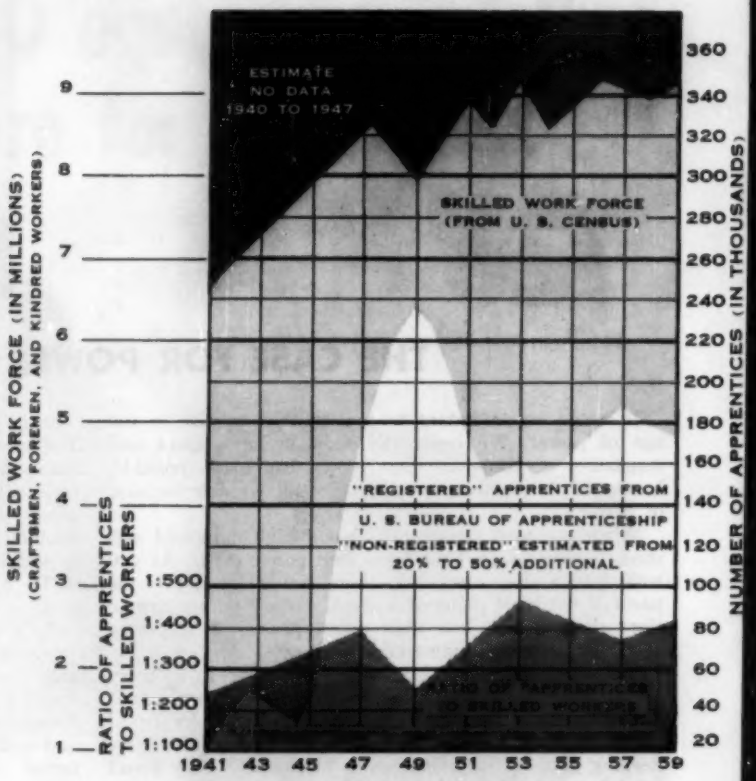
Today there are few power-mechanics laboratories in our schools because (1) we do not know how to organize the instructional content, (2) we do not have trained teachers, (3) we do not have good written instructional material, and (4) we are not ready or willing to shake off our old traditional programs. We believe the time has come to add power mechanics to teacher education programs in all colleges, to get some good basic texts in this field, and to do basic research that will indicate the facilities needed to operate a topnotch power mechanics program.

John L. Feirer

# our critical CRAFTSMEN shortage

EDWARD K. HANKIN

FIGURE 1. Apprentices and skilled workers, 1940 to 1959.




- Facing the nation in the coming decade: an **accumulative critical shortage of skilled craftsmen!**
- This article examines the causes in apprenticeship and vocational school programs and **suggests cooperation between them as a cure.**

A recent article in the *Journal of the American Society of Training Directors* opened with the statement, "One of the major problems that will confront the nation in the next 20 years will be the accumulative critical shortage of skilled craftsmen."[1] The author went on to outline the history of apprenticeship, describe the program as it currently operates, and point up its advantages as a means of providing a supply of workers for the skilled occupations. Most significantly he notes that, "Selective recruitment (for apprenticeship) has not been able to cope with the alarming losses that have been experienced in the skilled crafts."

[1]Barres, Stephen J., "Critical Craft Shortage and the Apprentice," *Journal of the American Society of Training Directors*, Vol. 13, No. 9, Sept., 1959, pp. 45–47.

**Dr. Hankin is head of the Vocational and Adult Education Department, Florida State University, Tallahassee.**

### Inadequacy of Apprenticeship

Time and again the inadequacy of the apprenticeship program to satisfactorily meet industry's need for skilled craftsmen has been noted. The Apprenticeship Law of 1937, to which Barres refers, was in itself a recognition of the need for the stimulation and expansion of apprenticeship. Kahler and Hamburger note that, "By 1937, although unemployment was still widespread, the scarcity of skilled labor was acute in many trades. Growing public awareness of the situation finally led to the passage of the Fitzgerald Act, the first Federal legislation related to apprenticeship."[2]

As far back as 1903, John Mitchell, then president of the United Mine Workers of America, wrote as follows: "As a result of the break-

[2]Kahler, Alfred, and Hamburger, Ernest, *Education for an Industrial Age* (Ithaca and New York: Cornell University Press, 1948), p. 21.

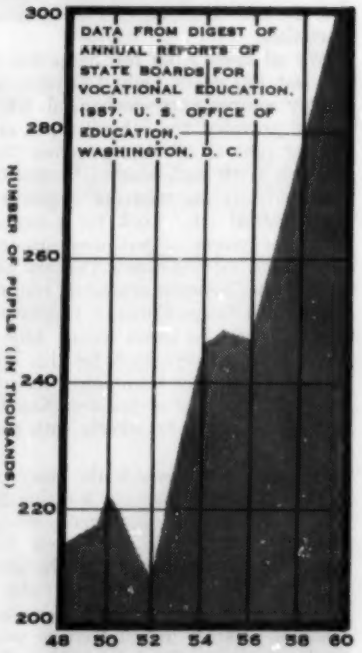



FIGURE 2. Enrollments in public day-trade vocational courses.

down of the apprenticeship system, the great mass of youth today receive little or no training in their particular trade . . . while in certain trades unmodified by the advent of machinery, apprenticeship in its old time form may still persist. In most cases, the system of indenturing boys for a long period must be definitely surrendered. . . ."[3]

Happily, Mitchell's dire predictions about the future of apprenticeship have not been as extreme as he suggested. Nevertheless, the inadequacy which he recognized at that time has grown worse. At the time of his writing, the ratio of apprentices to the total skilled industrial labor force was 1 to 88.[4] By 1940 this ratio had dropped to 1 to 180,[4] while in 1959 the ratio was 1 to *420*.[5] As shown in Figure 1, the trend in the number of apprentices has been upward, but it has never kept pace with the increasing size of the labor force and especially with the increasing proportion of industrial employment. This situation cannot help but be worsened by progressive automation with a shift in the proportionately larger number of skilled workers as compared to the number of semi-skilled and unskilled.

For many years, the supply of skilled workers produced through apprenticeship was supplemented by the immigration of skilled workers from European countries. With increasing restrictions on immigration, this supply has been greatly reduced and we are almost entirely dependent on skilled craftsmen prepared in our own country.

Quite probably the deficiencies in preparing a new supply of skilled craftsmen vary widely from section to section of the country. A 1952 report of the Lincoln and Therese Filene Foundation reveals how bad the situation was in Massachusetts. This Foundation surveyed 1088 industries that employed half of the state's skilled help. This report estimated that 25,000 young workers should enter the industries annually. The survey showed that industrial training programs in Massachusetts had about 5000 apprentices, and the combined annual output for skilled trades from the apprenticeship program and the vocational high school program was about 3800.

The national average situation appears to be only slightly better. A 1953 report of the Department of Labor pointed out that the nation needed 2,000,000 apprentices to supply the need for skilled workers. At that time, there were only 160,000 registered apprentices and an estimated 90,000 unregistered, which in total represents about one eighth of those needed for training. To this supply can be added the number being trained in the public and private vocational schools, but this was far too few to make up the difference.

The Department of Labor has summed up the reasons for the insufficient number of apprentices as follows: (1) educators who lay too much emphasis in high school on college and white collar jobs; (2) home and community influences which stress the importance of a "quick buck"; (3) not enough journeymen who can qualify as teachers; (4) lack of publicity to inform young men of opportunities in apprenticeship; (5) and finally, that discouraging first year in apprenticeship when long hours are spent in trivial tasks not connected with training for the future occupation.

### Vocational School Preparation

While much can and should be done to correct these conditions and to promote apprenticeship through the establishment of new programs and the expansion of existing programs, more attention also needs to be given to other sources of skilled craftsmen. Certainly we cannot sit back and wait for the whole problem to be solved through emphasis on apprenticeship alone.

In 1903 Mitchell also wrote: "The solution of the problem of training workmen is now being sought in industrial education. There is growing up in the United States an ever-increasing number of industrial schools well managed and equipped with all appliances and materials necessary for turning out efficient skilled workmen. It is probable that in the future many skilled mechanics will be graduated from the schools of this nature."[6]

The movement towards expanded vocational school preparation of skilled craftsmen, which Mitchell recognized, culminated in the passage of the Smith-Hughes Act in 1917. This and subsequent Federal acts to promote public vocational education has resulted in the establishment of vocational programs in every state and most larger population centers of the country. As shown in Figure 2, the enrollments in these programs rose to a peak early in World War II. After a sharp drop-off during the war years, they have risen steadily with the total number of enrollments exceeding the total number of apprentices.

While the existing public vocational program represents a substantial additional supply of skilled craftsmen, it, added to the apprenticeship program, still falls far short of the need. Barres' prediction of a critical craft shortage will continue to hold true unless some action is taken to alleviate this situation. Both the public vocational school people and the Bureau of Apprenticeship personnel are alert to the need for expanded facilities and increased recruitment for their respective programs. Among other things, they need the active support and assistance of both industrial management and labor to bring these things about.

### Combining Education and Apprenticeship

One plan being used for a few trades in some localities deserves more attention than it is getting. This plan represents a deliberate combination of public vocational education and apprenticeship. Carefully selected qualified young men are recruited into the public trade preparation programs at the beginning of their senior high school education with the explicit understanding that the education they receive in high school will be accepted as part of their apprenticeship in a skilled trade. Thus, when they graduate from high school, they are given credit for one, two, or three years toward their apprenticeship on the basis of the abilities developed while in school. As a result, the length of their post high school apprenticeship is reduced to a considerable extent, and they can look forward to employment on the journeyman level in a much shorter period of time. This especially applies to the many skilled trades which cannot be completely prepared for during the high school years. It produces a considerably larger number of apprenticeship graduates in proportion to the number of industrial training opportunities. By recruiting at an earlier age and before these young men get started towards other career objectives, this plan also tends to increase both the quality and quantity of young men seeking skilled trade preparation.

Reports of such plans that have been successful should be made available, giving details of how they work and the problems involved. Such reports would enable others to benefit from the experience gained and encourage expansion in this direction.

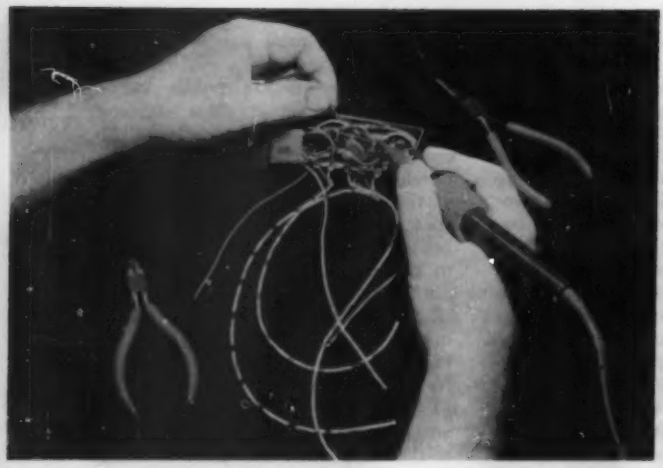
(Continued on page 66)

[3]Mitchell, John, *Organized Labor* (Philadelphia, Pennsylvania, American Book and Bible House, 1903), p. 261.

[4]Kahler and Hamburger, *op. cit.*, p. 20.

[5]Based upon figures released by U. S. Department of Labor and U. S. Census reports.

[6]Mitchell, *op. cit.*, p. 262.



Creativity in design and engineering (below) requires a careful analysis of data; creativity in production and manufacture (left) requires skill in use of tools.

# Encourage Creativity

ROBERT P. BALIN

- One of the industrial educator's greatest responsibilities is **encouraging creativity in all his students,** according to the author.
- Here is a brief, clear discussion of the subject to help you recognize creative students with a **12-point program on how to encourage creativity.**

The awesome power of creative imagination, and the ability it gives an individual to transform his world and ours into a new one of order, interest, and delight, makes it one of the most treasured of all human capacities. It is the creative individual who produces all that is new and different; who creates what we often cannot accept at first, but later come to like and love; and who makes discoveries at the limits of scientific endeavor. It would help us, as teachers, to know what kind of individual possesses constructive imagination in order to encourage this talent and assist in its development. Finding and helping creative students, and encouraging creativity in all students, may well become one of teachers' greatest responsibilities.

### Attributes of Creativity

What, then, are the characteristics of creative individuals? How can we recognize students with this ability? And what techniques do they employ that we should emulate? Research studies made at various universities[1] have shown the following to be some of their most noticeable attributes:

1. They are keen observers with an acute sensitivity of perception. They are quickly aware of anything that is odd, unusual, or promising in the person, material, or situation in which they are involved.
2. They have a flexibility of thought which permits them to adjust their thinking as the conditions of their problem change.
3. They tend to employ open planning with a broad purpose rather than an elaborate and specific set of carefully engineered plans.
4. They excel at separating a problem or project into its component parts and understanding the specific relationships between them.
5. They can ingeniously improvise and innovate to use functional objects in a new way.
6. They have the ability to hold

[1]Cornell University, W. L. Lambert. Pennsylvania State University, V. Lowenfeld. University of California, D. W. Mackinnon, R. S. Crutchfield, H. G. Gough, and R. Helson. University of Southern California, J. P. Guilford.

**Mr. Balin is a member of the Industrial Education Department, Arizona State University at Tempe.**

many ideas at once, to compare many ideas with one another, and thereby to make a rich synthesis.

7. They readily perceive order in disorder, and can combine many apparently unrelated elements in a creative way to form a new whole of practical value or aesthetic interest.

8. They show a preference for designs which are complex, asymmetrical, and, in their terms, vital and dynamic. They have an appreciation for art which many people would consider chaotic.

9. They derive satisfaction from eliminating superfluous detail in order to provide organizational economy in time, material, or facilities, all of which they will consider as part of a large, integrated whole.

10. They are quick to depart from stereotyped methods and standard operating procedures.

11. They have originality. This is often indicated by their ability to give an uncommon response.

12. They have more contact than most people with the life of the unconscious, of fantasy, reverie, and the world of imagination.

13. They see things as others do, but also as others do not.

14. They exhibit a great independence of judgment, and will not yield to a consensus of opinion.

15. They reject the demand of society that they adapt themselves to a norm for a given time and place.

16. They respect the irrational in themselves as the most promising source of novelty in their own thought.

17. They are described as being more primitive and more cultured, more destructive and more constructive, crazier and saner, than the average person.[2]

### The Conformist Spirit

Because the routine of schoolwork in the shop and classroom demands adherence to many administrative rulings it would appear that a highly creative individual is an unlikely prospect to fit the pattern of behavior required of a student. Several active forces are present which effectively suppress a student's desires for individual self-expression. The strongest of these is that relatively recent, but now almost universal, tendency to conformity among our younger generation.[3] This attitude is due, in a large measure, to parents who make their children feel guilty not so much about a violation of inner standards as about their failure to be popular. The parents' view is that "it is not what you know, but who you know" which insures success. In addition, the onslaught of advertising that suggests one's need for identification with the majority has also made conformity seem highly desirable, as well as socially acceptable.[4]

The conformist spirit, unfortunately, is not confined to the younger generation. Statistical confirmation is now available of a phenomenon of American life chiefly characterized by an extreme sensitivity to the opinions of others, with its concomitant lapse into unthinking conformity.[5] This trend is the reverse of our history and the American ideal which has always been, above all, individualistic. The future of our democracy would be more promising if we could restore a social climate which would reward independent thinking and truly enlightened co-operation in place of "going along with the crowd."

[2]Barron, F., "The Psychology of Imagination," *Scientific American*, pp. 151–166, Sept., 1958.

[3]Remmers, H. H., and Radler, D. H., "The American Teenager," Bobbs-Merrill, 1957.

[4]Packard, V. O., "The Hidden Persuaders," D. McKay Co., 1957.

[5]Reisman, D., Glazer, N., and Denny, R., "The Lonely Crowd," Yale University Press, 1950.

### How to Encourage Creativity

As teachers we can do something to bring about a much-needed renaissance of creative activity. To do this we must first understand that creativity is not the special gift of a very few, and that virtually every person has more creative ability than he is putting to use. Given the proper instruction, encouragement, and opportunity the creative potential of most of our students can be substantially increased. And we should not expect creativity to be only evidenced by a spontaneous burst of invention, for it is more often evolved from extensive preparation, inspiration, skilled analysis, incubation, and verification. For those who look for an easy path to recognition and fame, the hard work and slow development of a new idea may seem to take something from the uniqueness of a subsequent achievement. But while the world may soon forget, or never really know, of one's painstaking progress, it will never forget any small contribution that one can make to the sum of human beauty and understanding.

## how to encourage original endeavor

1. Provide ample opportunity for an individual's imagination to work, as well as teach the necessity of conforming to specifications.

2. Give additional credit to a student for his originality of approach to the solution of a problem or creation of a design.

3. Exhibit original works of art, crafts, literature, and unique solutions to problems in science and mathematics made by students and teachers in your school.

4. Display pictures of what is currently in fashion in the design of buildings, equipment, furniture, cars, and clothes in other countries.

5. Make comparisons between obsolete methods and those in use today, bringing out the advantages of the improvements that have been made.

6. Make comparisons between old and new designs which will show the trend of the changes in human needs, values, and tastes.

7. Try looking ahead to see what the world may need or like in the future.

8. Assign a problem requiring the modification of the outward design of an existing device.

9. Assign a problem requiring the application of an old device to a new purpose.

10. Plan co-operative efforts at creating a new device.

11. Occasionally ask the questions: "How do you think it works?" "How would you do it?" "Can you suggest an improvement?"

12. Try to be a little more original and creative yourself. Students learn as much from how you teach as from what you teach.

— Finley, Oakland Tribune

▶ since many parents seem to have an "apathy concerning shop grades," the author suggests "a few minutes . . . of self-appraisal" for industrial arts teachers to upgrade their subject so that we can —

# let's make it count

MERVYN T. JONES

Recently at a father and son junior high school meeting, I heard a group of fathers discussing the grades their children had received on their report cards.

As these laymen continued to discuss grades, subjects, and teachers, I was very much surprised by the answers that came forth from the dads. They would rattle off the grades in English, mathematics, social studies, and science and it would end there. I knew that this school had an industrial arts department, yet I heard no grades discussed in that subject. Finally, I heard one man state that his son had just a fair report card but he got an "A" in shop. The reply to this was, "Well, shop doesn't count." This statement coming from one man didn't concern me too greatly, but when I learned that this was the general opinion of the group, it certainly started me to thinking and wondering.

Surely the industrial arts teachers spent as much time and money on their education as the others, surely they spend as much time in preparing lesson plans, quizzes and tests. The school board spends as much or more money to equip the industrial arts classroom. Then why the general apathy concerning shop grades?

I know that industrial arts in junior high school isn't considered a "major" subject, but that is still no excuse for it "not counting." So I began to question the fathers. Most of them said the children never said it didn't count — the majority couldn't give a good answer as to why, they thought it wasn't important. One man suggested it might be because he didn't ever remember his son asking for help in shop homework or his shop notebook, or never saw him studying or preparing for a shop test.

Could it be the industrial arts teachers themselves are responsible for the lack of concern regarding the grades? Are the teachers grading the boys on only what they accomplish in the short classroom periods? Are the teachers requiring outside reading? Are pupils requested to keep an up-to-date notebook? In many cases none of the above are required and this may be one of the reasons why "Shop grades don't count."

If industrial arts is a part of general education, then it is necessary for us, as teachers, to do all in our power to upgrade it as much as possible. In our teaching we must insist that our students do their best at all times. Are you as an Industrial Arts teacher doing your best to keep industrial arts on a high school level, and to make it "count" in your school system?

Let's all spend a few minutes in retrospect. Let's do a thorough job of self-appraising. Don't compare your work with some fellow teacher's work; it is too easy to find flaws in his teaching techniques and then pat yourself on the back for not having made the same mistakes. It really isn't necessary to compare your work with anyone's, because you already know the proper techniques of teaching your subject. It is only necessary to check up on you yourself to discover if you have been doing everything you know how to do to develop the minds of the children entrusted to you. Ask yourself, "Is this the way I would want my own son to be taught this subject?" I'm sure you will be able to find a few faults with your own work that can be overcome easily with some extra effort on your part.

Begin by checking your lesson plans for the past few months. Have you followed them and accomplished what you expected to accomplish? Have you checked the students' notebooks lately? Are you keeping readable reference books for the students to use? Does your school library have an industrial arts section or shelf? Have you had any speakers from industry talk to your classes? Have you made any field trips to the many new industries in your vicinity? Have you given out of school assignments to your students? Are you keeping up with the new materials and methods of production in our modern industrial world? Are you taking advantage of the many visual aids made available by certain companies? In short are you really doing all you know how to do?

It will take better planning, more time, and more work to get started but the reward will compensate for the extra effort. You will enjoy it because first you are a teacher and secondly because you want industrial arts to count. ◀

**Mr. Jones was formerly an instructor of industrial arts with the Norristown, Pa., Schools.**

# How to Use a Research-Experimentation Approach

ARTHUR W. EARL

The challenge of industry* to industrial arts can be structured in a three-phase program:

1. The traditional industrial arts program to prepare young men to accept skilled positions in industry.
2. The technical industrial arts program to offer young men the type of background needed to accept technical positions in industry.
3. The *professional approach* to industrial arts, of which research and experimentation is one method, to provide young men with experiences that will enable them to accept research positions in industry.

These three industrial categories are effective parts of a forward-looking industrial arts department desiring to develop the best program for the students.

### Aspects of the Research Experience

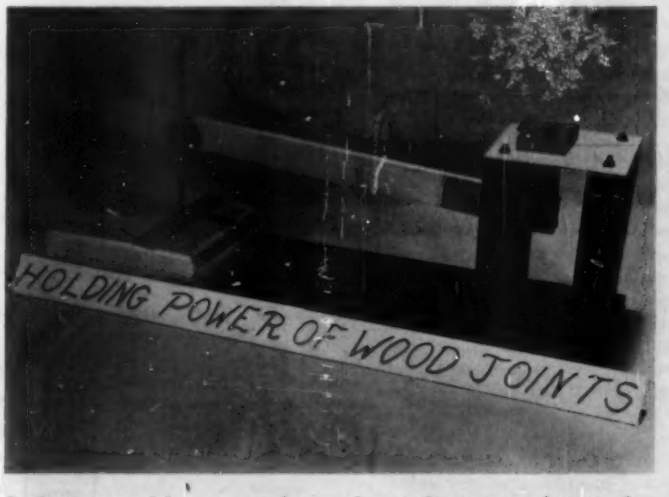
The research and experimentation program in industrial arts is a problem-solving approach to education. The students and teacher, together, form a technical team to define the problem, structure the procedure, conduct the experiment, and record the findings. The

*This approach will appear in a book, "Experiments With Materials and Products of Industry" by the author, McKnight and McKnight.

**Dr. Earl** is professor of industrial arts education at Montclair State College, Upper Montclair, N. J.

▶ **One of the three challenges of industry to industrial arts requires a professional approach of which research and experimentation is one method to provide young men with experiences for research positions in industry.**

▶ **Here is a complete description of this problem-solving program in which the teacher and student form a technical team to define a problem, structure the procedure, conduct the experiment, and record the findings.**




Equipment used in a research-experimentation approach to testing the holding power of dado, rabbet, and butt joints, fastened with glue, nails, screws, and dowels. Pressure to break the joint was applied by the turn screw over the scale. The lever arm, connected to the joint member protruding through a hole in the metal support plate, added sufficient mechanical advantage to break the joint and give a pressure reading on the scale.

recognized advantages are acknowledged by the students and teacher because of the depth and breadth of coverage leading to the solution of the problem.

1. Research challenges the student to explore the unknown.
2. Research problems investigated parallel in method, procedure, and equipment those of industry.
3. The investigative approach encourages students to examine references and contact industries.
4. The investigative approach requires students to examine many different materials and products.
5. The creative nature of research and experimentation fosters a type of freedom that helps to develop each student's individual ability.
6. The analytical nature of research and experimentation develops an awareness, on the part of the student, to the value of consumer shopping.

The satisfactions and understandings gained from the conception of an idea to the culmination of a finished problem readily justify the research and experimentation program because of the true-to-life experience it offers to the student.

### Depth of Pupil Research

The research and experimentation approach can be geared to the student's ability according to the simplicity or complexity of the experiment. Experiments may be conducted on an individual or group basis. Experiments conducted by a few individuals, while the rest of the class is engaged in other industrial arts activities, tends to arouse and stimulate interest in the research. An entire class engaged in research offers the opportunity to develop variety and complexity in the problems. Difficulty of the problem in the research and experimentation approach should not be the predominant factor; the method, which enlightens, challenges, and leads the student into clearer understandings of broad industrial concepts, should be primary.

Research and experimentation does not require an elaborate or special industrial arts laboratory. In a unit shop the research problem should be structured around the areas of work taught in that particular shop. Unit shops lend themselves very well to developing complex experiments in depth. The comprehensive general shop, because of the numerous areas taught, is more conducive to structuring a breadth program. The physical limitations of the industrial arts laboratory should not in any way restrict or limit the research experiments; instead, they should be used as a guide in determining the direction and depth of the research program.

### Structuring the Problem

The application of the scientific method to the solution of student research and experimentation points out the need for a team approach. The team approach is essential to the preliminary discussions, selection, and defining of the research problem. One student may present an idea. However, as in industry, the merit of the research problem and its many ramifications will be thoroughly discussed by the research team. The research team in this case will be composed of students and the industrial arts instructor. The logical presentation and systematic approach required to clearly define and limit the research problem is a challenge to the imaginative mind of the student.

An example of a research problem applicable to the industrial arts laboratory is presented below. The topic, Strength and Flexibility of Wood, is organized in a basic research outline form.

### Helpful Hints

The quality of learning that takes place in the research and experimentation approach is dependent upon the effort expended by the student. The teacher, to insure the most success for the student, should encourage the undertaking of as much background preparation as possible. Several suggestions may be followed in an effort to help the student get the most out of his experiment.

1. Study the problem thoroughly.
2. Search out all the written material available.
3. Establish precautions that are necessary to make the experiment valid.
4. Prepare a list of assumptions that will help to insure a properly structured experiment.
5. Prepare a list of questions which need to be answered, and which may

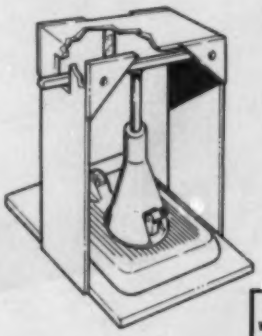
---

I. *PROBLEM*

To determine the strength and flexibility of edge, cross, and plank grain wood.

II. *MATERIALS*

Enough pieces to permit a minimum of three tests with each type of wood to be tested.



The strength and flexibility of wood apparatus is shown above and the strength and flexibility of wood table is shown at the right.

Cut all of the test samples for the edge, cross, and plank grain wood to the same thickness, width, and length.

III. *EQUIPMENT*

Construct the strength and flexibility of wood apparatus. (The drawing of the accompanying test apparatus is intentionally simplified since one phase of the problem is for the student to design and develop his own testing apparatus.)

Make the apparatus of heavy material to provide enough strength to bend and break the different types of wood.

Place a piece of pipe, to act as a roller bearing, over the bolts.

Suspend a ruler, to measure the amount of bend, from the center of the top back edge.

Use a bathroom scale with as high a reading as possible in order to meas-

| WOOD | GRAIN | | | | | |
|---|---|---|---|---|---|---|
| | EDGE | | CROSS | | PLANK | |
| | strength | flexibility | strength | flexibility | strength | flexibility |
| ash | | | | | | |
| basswood | | | | | | |
| cedar | | | | | | |
| cherry | | | | | | |
| gum | | | | | | |
| mahogany | | | | | | |
| maple | | | | | | |
| oak | | | | | | |
| pine | | | | | | |
| poplar | | | | | | |
| walnut | | | | | | |

be answered by the findings of the experiment.

6. Accuracy throughout the experiment is important. The end result will only be as valid as the pupil makes it.

### The Research Challenge

Research is undertaken to obtain new knowledge. Properly organized and delimited, the research and its results will show that the hypothesis (the guess the student makes concerning the outcome of the study) was right or wrong, accurate or inaccurate. In the research approach, success is not measured by the traditional industrial arts achievement measure, the finished project. Instead, success and achievement are measured by the quality of the *entire experiment*.

The outstanding student may find the research and experimentation approach such a challenge that he will elect industrial arts. College bound pupils electing industrial arts could benefit from such a course, especially if it were offered for full credit.

The student with less ability, may find interests to his liking in the research and experimentation approach. Many times students do not desire to make a project, however, they do have an interest in shop, especially if it is varied and does not require detailed project work. Research problems structured according to the slow student's ability, therefore, may help them to find a degree of success in industrial arts.

Research and experimentation, although a new concept in industrial arts, is proving to be very successful both in public school and college. At the same time, there is still much more that can be done to further the educational values of research and experimentation. It is an accepted principle that man's strength lies in education. And man's weakness stems from ignorance. This indicates that yesterday's industrial arts, although good, is not enough. Today's industrial arts should produce — a *thinking pupil*. A pupil, intellectually and materially, is more fully prepared for a lifelong occupation involving creative thinking, if he has the opportunity to develop the pioneer spirit and blaze the new trails of ponderables, imponderables, things and ideas.

Therefore, let us as educators have the insight to help pupils develop and grow to maturity by recognizing the inherent values of the Research and Experimentation Approach to industrial arts education. ◀

## a typical working outline

ure the force required to bend and break the strongest type of wood.

A car jack will provide the necessary amount of controlled pressure to operate the apparatus accurately.

IV. *PROCEDURE*

1. Mark the type and grain of wood, for identification purposes, on each test sample.
2. Center a piece of edge grain wood in the test apparatus.
3. Operate the apparatus.
4. Observe closely the pounds of pressure required to break the wood.
5. Run three edge, cross, and plank grain strength tests on each type of wood.
6. Record the average findings in the strength and flexibility of wood table.
7. Center a piece of edge grain wood in the test apparatus.
8. Operate the apparatus.
9. Observe closely the bend in inches required to break the wood.
10. Run three edge, cross, and plank grain flexibility tests on each type of wood.
11. Record the average findings in the strength and flexibility of wood table.

V. *PRECAUTIONS*

Select a good grade of straight grain wood free of wind, knots, and checks.

Surface all of the wood to the same thickness, width, and length. Variations in the surfacing and size will cause discrepancies in the strength and flexibility of the wood.

Extend the test samples far enough through the side openings of the strength and flexibility of wood apparatus to allow maximum bending of the wood.

Center each piece of wood accurately in the strength and flexibility of wood apparatus. Variations in the positioning can cause the pressure and flexibility readings to be invalid.

Apply slow even pressure with the jack while conducting each test. Avoid any sudden jerky motion that will tend to cause erratic scale operation.

Observe the scale and ruler closely in order to be accurate in the strength and flexibility readings. Carelessness with these factors will cause variations in the results.

VI. *FINDINGS*

Conduct the experiment and record the findings in the strength and flexibility of wood table.

VII. *REFERENCES*

*Comptons Pictured Encyclopedia* (Chicago. Ill.: F. E. Compton and Company), Volume XV, 1954 Edition.

Fryklund, V. C. and La Berge, A. J., *General Bench Woodworking* (Bloomington, Ill.: McKnight and McKnight Publishing Company, 1940), 152 pp.

U. S. Department of Agriculture, *Bending Solid Wood to Form*. Agriculture Handbook No. 25, Forest Service, 1957, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

**Two examples of research equipment: (above) wood, metal, shingles, and paint were tested for heat reflection and transmission properties in which a sun lamp directed intense light and heat through a long tube onto the material tested and thermometers registered heat transmission and reflection; (below) the acoustical properties of all types of construction materials were tested for their sound absorbing qualities in which an oscillator speaker provided sound vibrations and a microphone, connected through an amplifier to a voltmeter, picked up the vibrations to a voltmeter scale.**

# Designing for Welding

The teaching of manipulative skills is but one aspect of the industrial arts program; equally important is the development of the ability to use these skills in real situations.

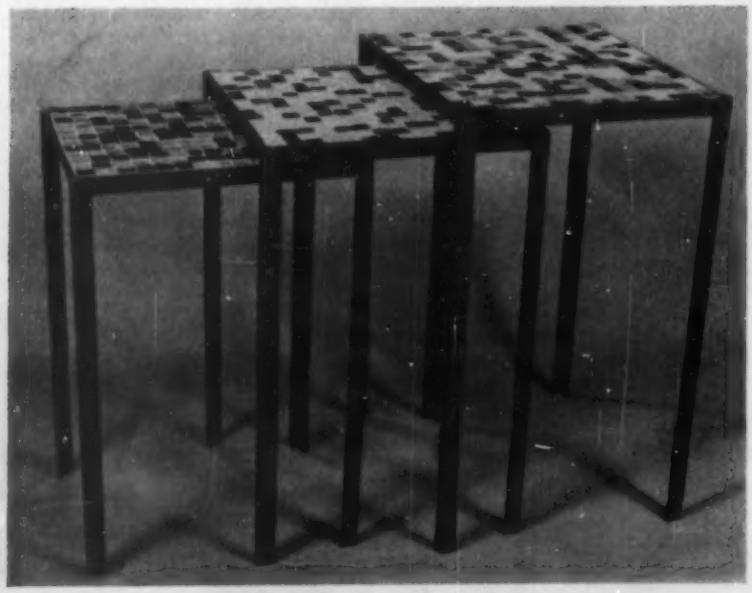
Many of the common industrial processes provide interesting challenges with regard to their teaching. Welding, for example, is generally introduced to students in the form of exercises; students practice on bits of scrap material, developing and perfecting their skills in arc and gas welding, and in brazing.

With only the degree of skill acquired, the fullest possibilities of the learning experience is not realized until individuals turn to projects or problems which will permit them to apply this newly acquired skill to a practical design task. The endemic reply to the matter of including design experiences in the shop program is, "There is simply no time for it; I am too busy teaching the skills."

In answer to this, it can be pointed up that only with some effort by the instructor is it possible to combine the cultivation of manipulative skills with those of design and planning. The plea here is for affording the pupil the opportunity to participate in design activities of an individual and meaningful nature wherever possible. Starting at the earliest period of organized industrial arts work, some provision should be made for the pupil to know the joys and satisfactions of creative design.

Welding, one of the most important metalworking processes, frequently poses problems regarding the selection of good, applicable project activities. Endless possibilities for good welding projects exist in metal tables. These not only permit the designing of very useful items, but further require one to design with a specific process in mind. The student must make the usual decisions regarding the function of the table, the dimensions, the type of material used, and finish.

Beyond these considerations, however, he must decide which type of weldment will best suit his particular case: Is there a best type of weld to use on tubing? On angle iron? Should arc welding, gas welding, or brazing be used? What are the relative merits of fillet, bead, slot, and the various groove welds? Will some other means of fastening, other than welding, be best employed here? If so, perhaps the total design approach should be changed. It should be remembered that in all design tasks, the best possible applications of materials and processes must be kept in mind.



The designing must begin from a consideration of the use to which the table will be put; planning a table for the workshop is different from planning one for the bedroom. For purposes of discussion here, let the object be a small side table for use in the living room or patio. The dimensions of the table will be controlled by this use; it should be of convenient height for use alongside a chair or sofa; its surface should be large enough to contain a glass, an ashtray and a small plate. This is the type of reasoning which should take place in order that, in all cases, the designing will meet the needs of a specific situation. Moreover, one may decide to extend the design thinking to the possibilities of nesting, or step tables, illustrated in the photograph. These, of course, must be planned so that they will easily pass under one another, or "nest" properly. With the definition of use clearly in mind, one can turn to the other aspects of the design task.

In the course of learning the welding skills, the students, as indicated earlier, usually practice on scrap pieces of stock. They practice fillets and beads, horizontals and verticals; they work with angle and tube and bar; they familiarize themselves with both ferrous and nonferrous metals. Furthermore, they can experiment with various modes of organizing the members of such things as leg joints. The accompanying drawing illustrates two means of accomplishing this in angle iron; others may be devised using other material forms. The drawing further illustrates the joints as used in a typical table design.

The shape of the top can be square, rectangular, round, or triangular; the use of the freeform design should perhaps await the mastery of the simple geometric forms. The top framework can support a piece of tempered hardboard, to which is affixed ceramic tiles in a random pattern. This top is especially desirable for the table which will be used out-of-doors, and exposed to the weather. Other possibilities exist, such as glass, etched glass, wood, plastic laminates, or veneers.

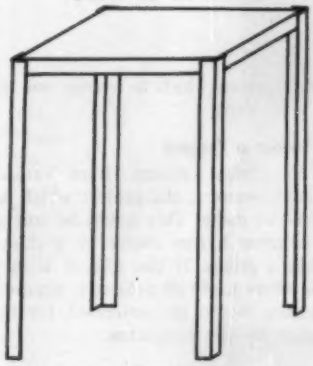
A neutral finish for the metal, such as flat black, is wisely chosen, for it is frequently difficult to obtain a precise match with the top color. This is especially true in the case of a ceramic tile surface, where the brightly finished framework may detract from the hue of the top.

Tables such as these, plus other products of the student designer's imagination, make excellent means of applying the acquired welding skills.

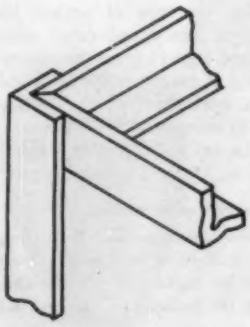
▶ the seventh in a series of articles on how to apply **principles of good design** to I-A instructional areas —

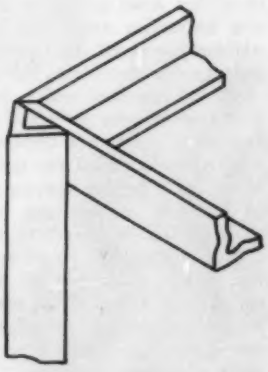
# DESIGN for the TEACHER

**john r. lindbeck**
Associate Professor of Industrial Education, Western Michigan University, Kalamazoo, Mich.

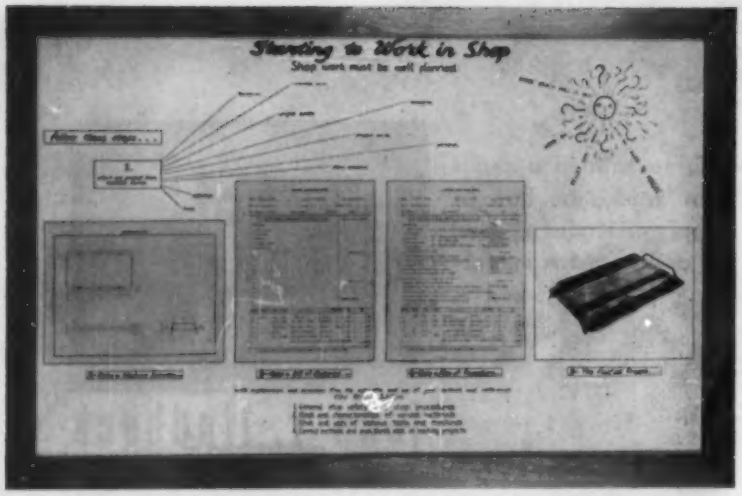


METAL TABLE
SUGGESTED DESIGN





WELDED JOINTS
SUGGESTED DESIGN




▶ a guide to the performance of the necessary steps in planning the typical shop project —

# An Aid to Project Planning

CARL R. BARTEL

Project planning is an important part of industrial arts work and should be given more emphasis than it usually receives in the typical shop. It is all too often that we take the planning step or "objective" for granted and just hope that the student will be able to perform the necessary steps or processes in correct or accepted order. There is, undoubtedly, a great difference in the amount of detail which various instructors require of students in planning their projects; but no matter the degree of detail, instruction in planning, to be effective, needs to be supplemented with the necessary aids.

The visual aid "Starting to Work In Shop" has aided greatly to make planning instruction more effective and in addition has saved thousands of words and valuable class time. This particular visual aid has been and is being used with students who have had six weeks or more of mechanical drawing. During this six weeks period the fundamentals of making a working drawing are taught so that the student can draw each project which he intends to make.

This visual aid is placed on the shop wall so that a student, at any time during his planning stages of his project, may refer to the aid. The aid is based on the five steps: (1) select a project, (2) make a working drawing, (3) make a bill of material, (4) make a plan of procedure, (5) finished project. The student is furnished with a standard shop work sheet on which he carries out his planning steps.

### 1. Select a Project

The student selects, from various available sources, the project which he desires to make. This would be true if he is given a free choice or a choice within a group. If the student is in a class where a certain project is required, this step would be performed for the student by the instructor.

### 2. Make a Working Drawing

After the student selects a project he is required to make a working drawing, to scale, of the project. The number of views and the amount of detail will depend upon the type of project and also on the accuracy and detail which the instructor expects from the student. The drawing is made on the back side of the shop work sheet which is 8½ by 11, except in cases of large and complex projects. Large and complex projects are drawn on 11 by 15 drafting paper.

### 3. Make a Bill of Material

When the drawing has been completed the student is required to figure the cost of his particular project which he does on the bottom of the face side of the shop work sheet. It is at this time the related information "figuring cost of materials" is taught to the student. This definitely has more meaning to him than if it were taught in a matter-of-course way.

**Dr. Bartel is assistant professor, Industrial and Technical Education Department, Utah State University, Logan.**

### 4. Make a Plan of Procedure

The procedure step follows the bill of material step. The student is required to write down, step by step, the procedure he will follow in constructing his project. A large reference library is used from which students can get information to fill out the plan of procedure, with the aid of the instructor. In case a certain beginning project is required, the plan of procedure is usually given to the student to copy on his shop work sheet. The amount of detail in making out the procedure plan depends on the advancement of the student and on how much the instructor requires.

### 5. Finished Project

The purpose of this step on the aid is to show that if a student follows the earlier steps, he will come out with a well-designed, well-constructed, useful project.

It is understood that necessary demonstrations and related information will be given when needed to the students. I feel sure this aid will be of as much help to you as it has been to me in working with junior and senior high school students. ◀

# PLAQUES IN THE JUNIOR HIGH SCHOOL FOUNDRY

**MICHAEL C. PERNO**
Metal Shop Instructor
Derby Junior High School
Birmingham, Mich.

Many junior high school students have been limited in their foundry experiences to molding and casting commercial or hand-me-down type flat patterns. As a result of this practice some students lose interest in the foundry area.

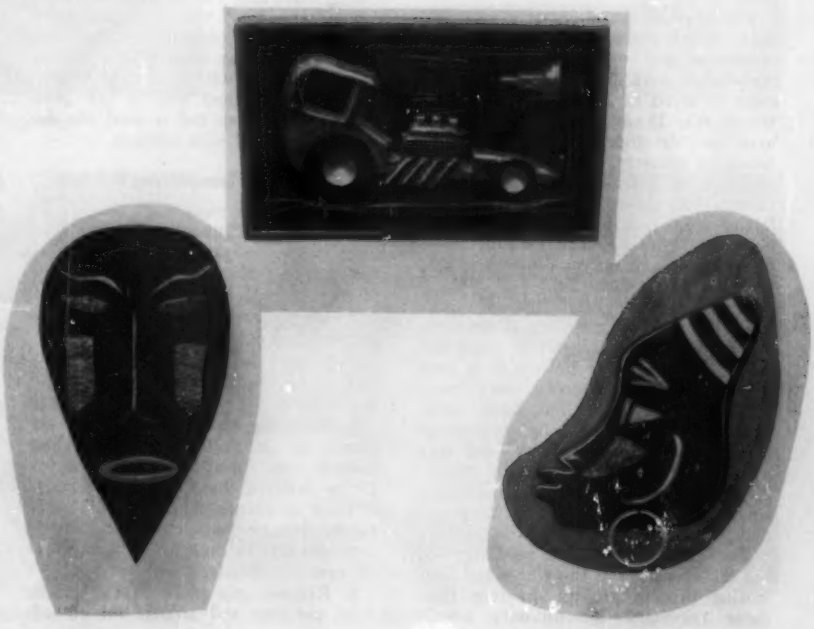
As an industrial arts teacher the author often wondered if it might be feasible for junior high school students to design and form their own patterns. This would provide an excellent opportunity for the student to express his own ideas and creative abilities. After considering several different materials that could be used by the students to form a pattern, he decided to use ordinary oil base molding clay.

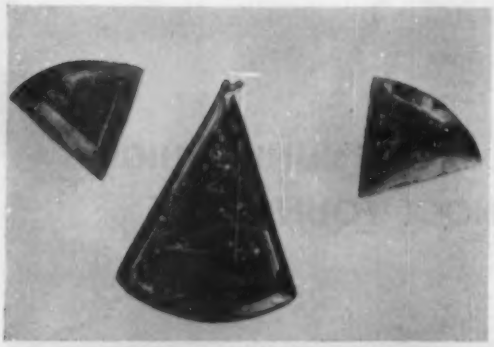
The mask and plaque type projects seemed to be ideal for this venture. These projects present an excellent opportunity to teach a few basic fundamentals of pattern making and the need for good design. They also provide an ideal occasion to correlate industrial arts and art.

The pattern is formed by working the clay on a flat surface of wood or metal. A sloyd knife and a few improvised molding tools are invaluable in forming the pattern. After the pattern has been formed to the desired shape, check all surfaces for sufficient draft allowances. The pattern can now be cut free from the working surface with a thin piece of sheet steel. Apply parting compound to all areas of the pattern and allow the pattern to set a day before using. This will enable the clay to harden and will produce a smoother mold and a cleaner casting.

The pattern is rammed in the same manner as any other flat pattern. However, care must be taken not to ram the drag too hard. One must remember that this pattern is made of clay. After the pattern has been completely rammed, it is drawn from the sand by using ordinary wood screws for draw screws.

The project can be finished in a variety of ways. Again, the student has the opportunity to use his imagination. Some areas can be peened and wire wheeled, others can be peened, painted and then high-lighted, while others can be painted solid.





# EMBEDDED LAMINATED PLASTIC JEWELRY

**WILLIAM C. McNEICE**
Industrial Arts Department, Newark State College
Union, N. J.

The progressive industrial arts teacher is an individual who is continually looking for new ideas to motivate his students or experimenting with the basic raw materials or the variety of new materials available to determine their limitations. The field of plastics presents a significant challenge to both education and industry. As its name implies, it is a material that can easily be bent, twisted, molded, or remolded into a form or shape.

The average industrial arts program today includes many of the basic types of plastics and provides experience for the student with the fundamental processes involved in its fabrication. Since World War II, many types of plastics have been developed and processes perfected by industry. Many industrial arts programs still do little, however, with plastics because of cost. The embedded laminating plastic process is inexpensive in nature because it makes use of odds-and-ends of a variety of materials and pieces of scrap plastic.

Educators have been stressing creative design. When a student is developing a piece of plastic jewelry using the embedded laminating process it is necessary for him to consider such basic elements of design as: line, shape, mass, tone, color, texture, balance, proportion, rhythm, repetition, harmony, and emphasis. The ultimate success of the individual student is directly proportional to his imagination, initiative, ambition, and interest.

The tools and materials necessary for the incorporation of the embedded laminating process are no different than those necessary for ordinary plastic fabrication. These include a coping saw, a 2nd cut mill file, and a "C" clamp or parallel hand screw. The materials necessary include an opaque and transparent acrylic plastic, methylene dichloride, 4/0 and 8/0 wet or dry garnet paper, 3/0 steel wool and the material to be embedded in the plastic.

The material embedded between the plastic laminations includes such materials as seed beads, glitter, sequins, string, wool and cotton yarn, artificial rhinestones, screen wire, 20-ga. annealed copper wire, and copper foil. When annealed copper wire is used it is recommended that the wire be bent to desired shape and flattened with a ball peen hammer. If copper foil is used, the designs are cut out with scissors.

### The Embedded Laminating Process

1. Select two pieces of plastic approximately the same size. At least one piece should be transparent.

2. Remove the masking from one side of each piece of plastic.

3. Select the material to be embedded between the plastic laminations.

4. Using a shallow tray, pour methylene dichloride into it to a depth of about ⅛ in.

5. Place the exposed surfaces of the plastic in the shallow tray and allow them to soak for at least three minutes. If the material that is to be embedded is thick in nature, such as seed beads, rhinestones, or coins, the plastic should soak in the methylene dichloride for at least ten minutes.

6. Remove one piece of the plastic from the tray and arrange the embedding material on the dissolved surface as quick as possible. The student must work fast, or the surface will dry out and the embedding material will not become emulsified in plastic. After the material is arranged, the other piece of plastic is carefully overlaid on top. It is not absolutely necessary that all air bubbles be removed. They too possess character that may be incorporated into the design of the piece of jewelry.

7. Clamp the two pieces together with a parallel hand screw or "C" clamp. Allow at least two hours for the laminated material to dry.

8. After the laminated piece is dry, remove the masking paper from the transparent side of the plastic and select the area of the embedded material that suits the individual's taste or need. Replace the masking paper and draw the design over the selected area.

9. Cut out the chosen design with a coping saw or a scroll saw.

10. After the object is cut out, the edges may be beveled on a disk sander or rounded with a 2nd cut mill file.

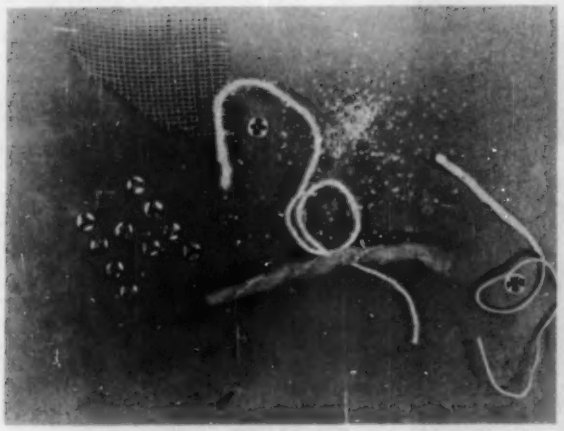
11. Sand all edges with 4/0 wet or dry garnet paper and water. Repeat this process with 8/0 wet or dry garnet paper.

12. Rub all edges with 3/0 steel wool.

13. Before removing the masking paper be sure that all tool marks are removed. If so, remove the masking paper from both sides and buff all surfaces to a high gloss. If a buffer is not available, a satin luster may be obtained by using 3/0 steel wool and machine oil together.

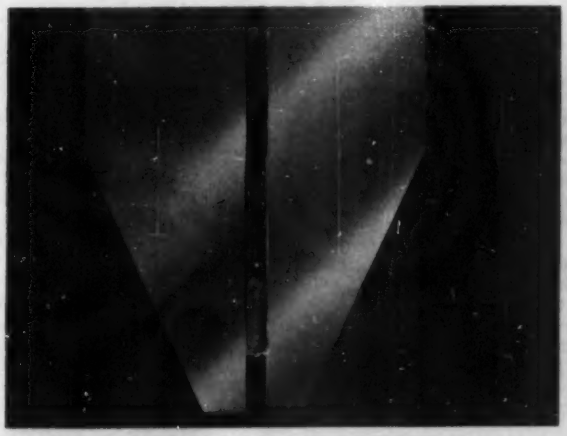
14. Attach the necessary findings and the project is complete.

# . . . steps in creating embedded laminated plastic jewelry

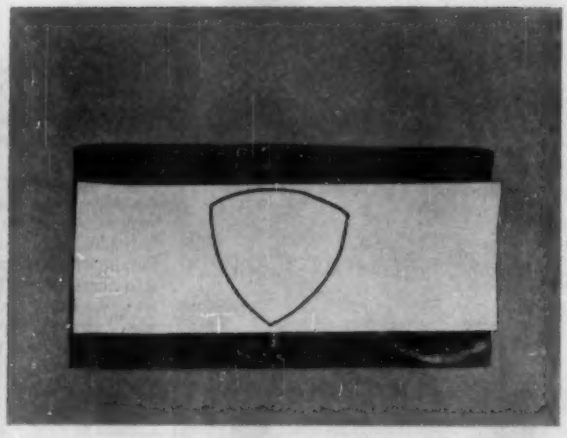


Select the material to be embedded

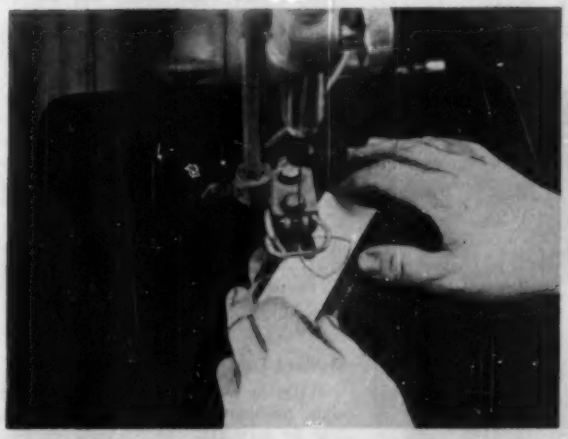
Pour ⅛ in. methylene dichloride



Clamp the laminations together



Draw design over selected area



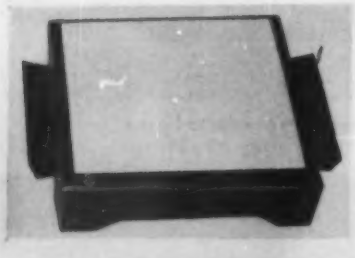
Cut out the chosen design

Bevel and sand all edges

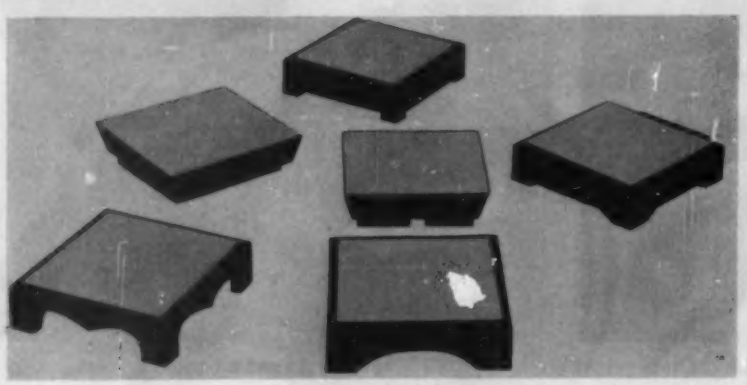
# HANDSOME TRIVETS COMBINE LAMINATED PLASTIC AND WOOD

**PATRICK SPIELMAN**
Instructor, Gibraltar High School
Fish Creek, Wis.

Every student's mother will welcome with joy one of these smartly designed trivets. Ideal for under casseroles, hot dishes and coffee pots, this trivet project will protect table top finishes from heat and moisture condensation damage. Laminate is one of the new plastic materials which is rapidly finding its way into nearly every home on kitchen counters, vanities, and tables. What better way can a student appreciate this fascinating material than by actually using it in constructing a project?



Illustrations of the variety of designs available from scrap plastic laminate and wood (some with handles, as shown at left).



Laminated plastic will withstand a considerable amount of intense heat without deterioration or deformity. The trivet withstood a test of placing a boiling pot of water on it with no noticeable effects. However, on a large surface like a counter top the laminate may possibly bulge or bubble when a hot dish is continually placed on it. This is due to the fact that the heat on the area directly under the dish causes the laminate to expand while the other area is of normal temperature, thus forcing the bubble. This expanding does not affect the trivet because of the small area. The trivet then may even be used to protect hot dishes from possible expanding or bulging of large laminated surfaces like countertops and kitchen tables.

Plastic countertop laminate comes in an array of colors and designs such as marble, speckled, and wood grain patterns. When selecting the plastic laminates, a striking appearance will result if the laminate is of a contrasting color to the finished wood. The trivets in the photographs were constructed of black walnut and white plastic laminate with a gold speckled design. Small pieces of laminate may be purchased as scrap at relatively low cost from lumber yards or cabinet shops. If purchased in full sheets the cost will be considerably higher.

### Student Design

With the evergrowing demand for design problems in industrial arts the teacher may have the students originate their own designs. The trivet designs in

the group photograph are not the only possible designs. Perhaps other methods of construction can be worked out which would influence a wider selection of designs. Dimensions may be changed to meet a specific need.

The two methods of constructing the trivet made here are: (1) laminate plastic to a solid base made up by gluing two pieces of ¾ in. stock together and nailing on small blocks for legs; (2) laminate plastic to ½ in. plywood and cover the edges with a mitered frame which has the legs cut in as part of the frame design.

### 1. Solid Base Construction

Built up or solid stock may be used for the base. Begin by cutting out the base and laminate 1 in. larger than the finished size as shown on the drawing. Prepare to laminate plastic by smoothing and cleaning adjoining surfaces from dust and dirt. Powdered resin glue may be used, but it is believed that regular counter top contact cement will produce the most favorable results. Follow the manufacturer's directions on the can. Usually all you have to do is brush on cement to adjoining surfaces and leave until dry, then press together. A greater bond is obtained if pressure is applied with a hammer and a block of wood.

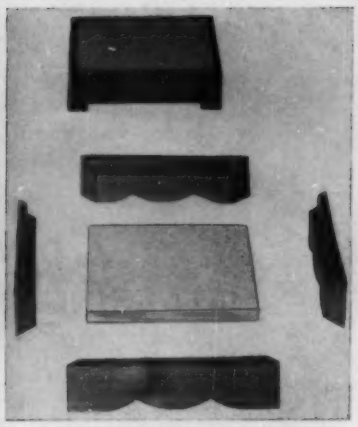
Next cut to size using a fine tooth crosscut blade on the circle saw tilting the arbor to 15 degrees. Do not use a rip or combination blade because these cut too coarse, thus chipping the laminate. Smooth wood by planing or with abrasive and use a single cut file to smooth laminate and round sharp edges. The legs are made and nailed or glued to the bottom, ¼ in. from the corners. Finish as desired. Do not worry about excess finishing materials getting on the plastic laminate. After the last coat of finish has dried, the laminate may be cleaned with 3/0 steel wool. Felt or flock on the bottom of the legs will protect the trivet from scratching other surfaces.

### 2. Frame Construction

This method offers a greater selection of designs, but entails a little more accuracy in cutting the various pieces. Begin construction by cutting the plastic laminate and ¼ in. plywood about 1 in. larger than the finished dimensions. Secure plastic to plywood as described above. Cut square with fine tooth blade. Next, cut a ⅜ in. rabbet exactly ½ in. deep so the frame will cover the plywood edge and leave the thickness of the laminate raised above the frame. The edge of the frame next to the laminate should be rounded or chamfered to prevent damage to the wood finish by hot dishes. Make miter cuts and select design and cut out. Smooth with abrasives and assemble with glue and brads. Set brads, fill holes, and finish as desired.

### Handles Optional

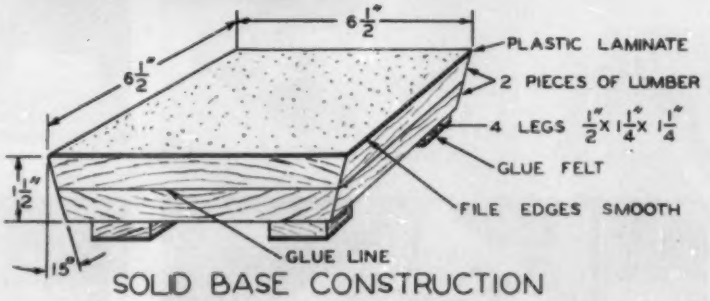
The handles illustrated in the photo and drawing may be added to give greater serviceability to the trivets.



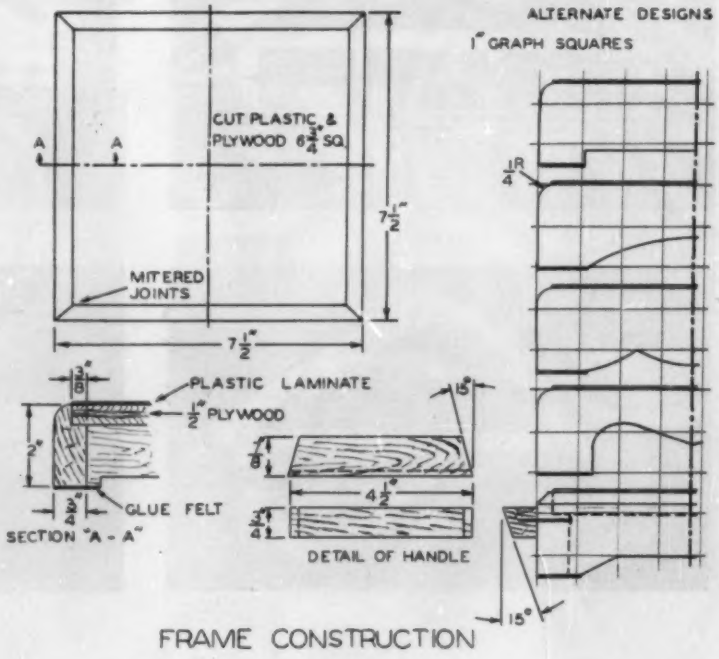
Above, left: cutting to size with fine tooth blade tilted to 15 deg.

Left: using block of wood to pressure laminate.

Above: the frame type of construction, before and after assembly.




SOLID BASE CONSTRUCTION




FRAME CONSTRUCTION

▶ for vocational carpentry courses —

# A DEVICE FOR TEACHING ROOF FRAMING

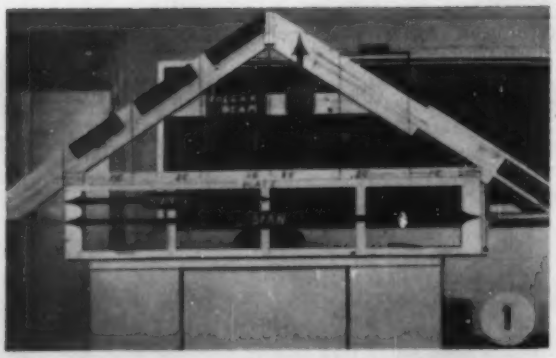
**DONALD W. SHERMAN**
Instructor of Vocational Carpentry
Berwick Area Joint Senior High School
Berwick, Pa.

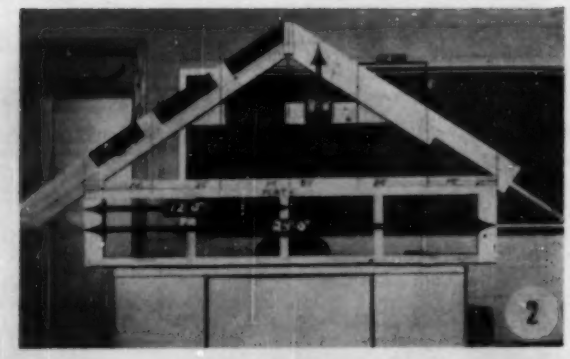
The accompanying pictures show a visual aid which was developed and used very successfully for each of the lessons described below. This visual aid was first conceived to teach roof terminology to 11th grade students; as it was being built, however, various other possibilities presented themselves. This aid was built almost in its entirety by 10th and 11th grade students.

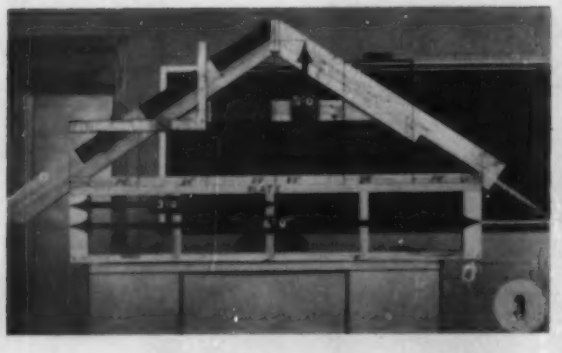
Photo No. 1 shows the aid being used to teach roof terminology. The names of the various parts or dimensions are printed with chalk on the green chalkboard. Students follow by filling in names on a duplicated drawing.

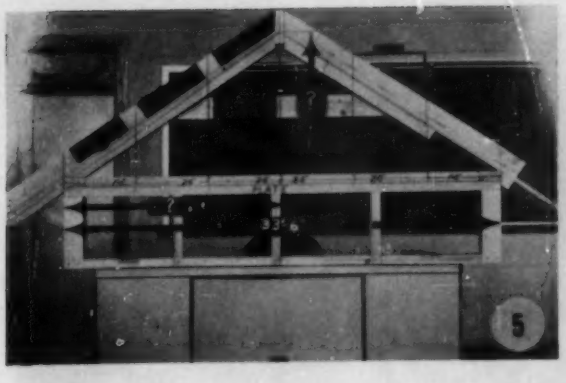
Photo No. 2 shows the aid being used to teach fractional pitches. Many combinations can be developed for this purpose.

Photo No. 3 pictures the aid with framing square attachment for the teaching of rafter framing using the step-off method. Square can be moved on rafter to each step-off position, showing graphically how square advances one foot of level run for each step taken with the square up the rafter. Projection lines from plate to rafter are black painted wires. Also shown realistically

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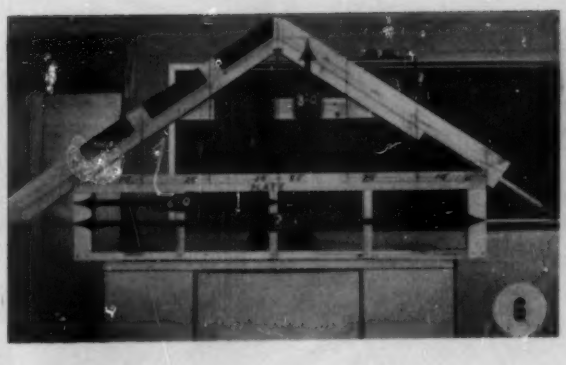
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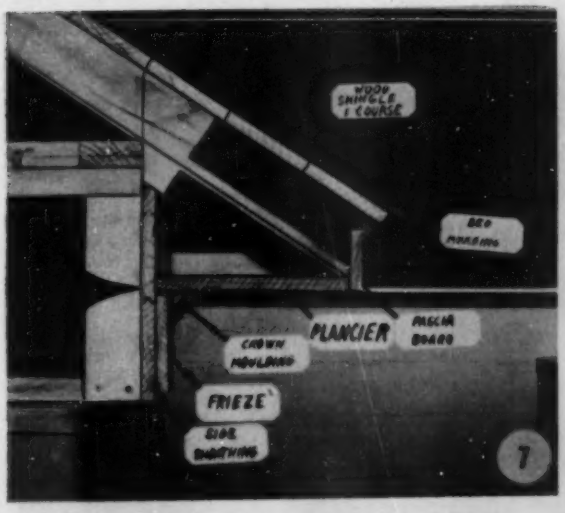
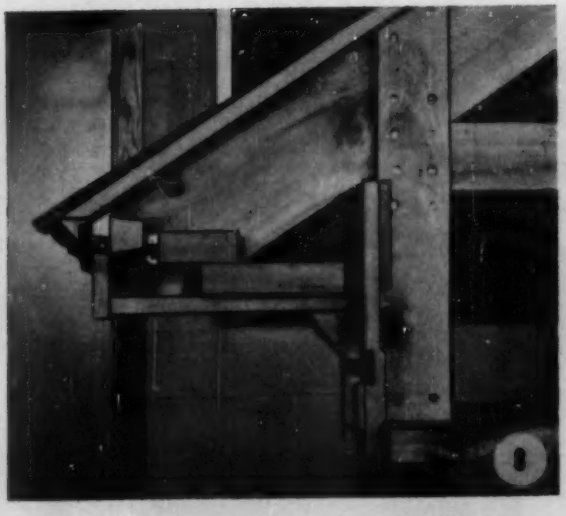

WOOD SHINGLE 1 COURSE
BED MOULDING
PLANCIER
FASCIA BOARD
CROWN MOULDING
FRIEZE
SIDE SHEATHING
7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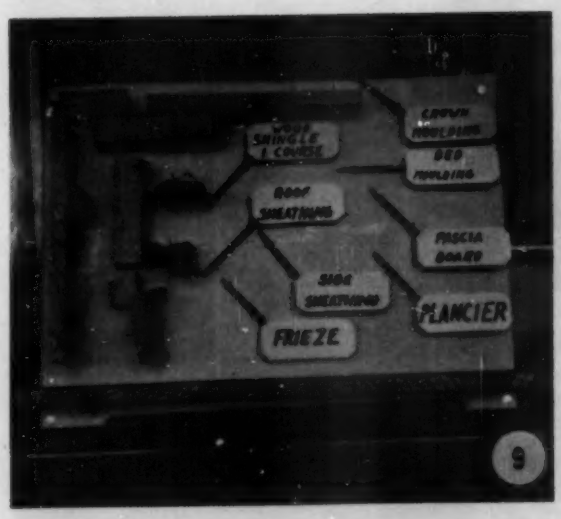
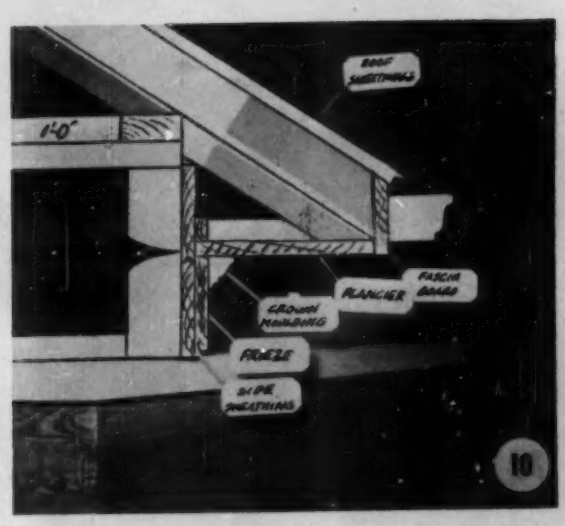
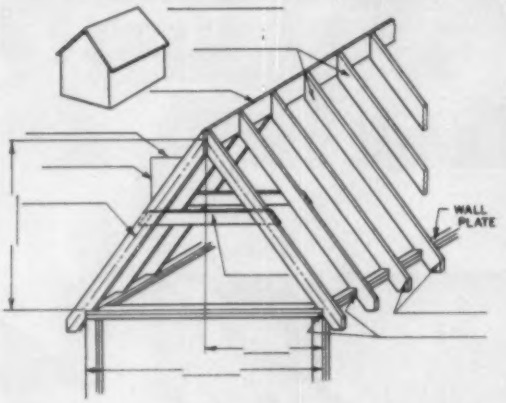

WOOD SHINGLE 1 COURSE
CROWN MOULDING
BED MOULDING
ROOF SHEATHING
FASCIA BOARD
SIDE SHEATHING
PLANCIER
FRIEZE
9


ROOF SHEATHING
1'-0"
FASCIA BOARD
PLANCIER
CROWN MOULDING
FRIEZE
SIDE SHEATHING
10

**TITLE:** Names and Meanings of Roof Parts of a Gable Roof

**COURSE:** Carpentry

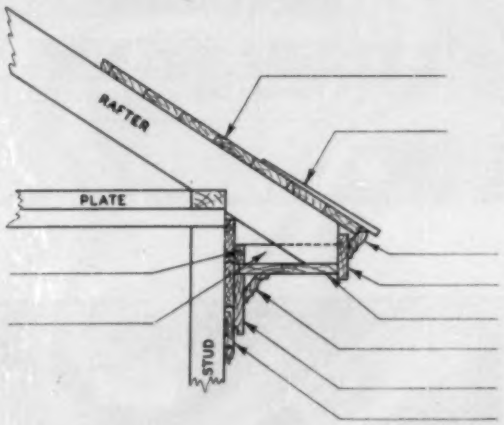
Shown below is a drawing of a portion of a roof. Ceiling joists and studding have been purposely left out for clearness. As the instructor gives names and describes purpose of parts, place name in proper blank.




**TITLE:** Construction and Terminology of a Box Cornice

**COURSE:** Carpentry

Shown below is a section of roof at cornice showing various parts and their relation to each other. As the instructor gives names and describes purposes of parts, place name of part in proper blank.




Two typical information sheets to be used with the roof terminology visual aid.

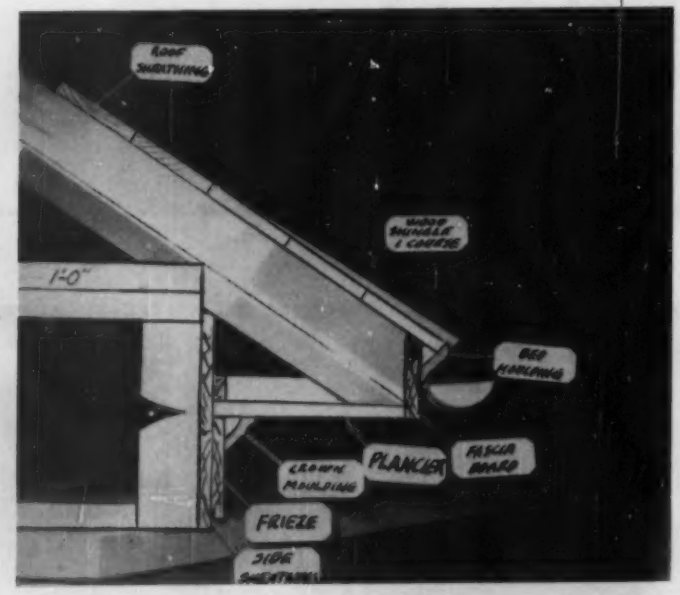



Photo 11

is the reason why all level cuts are marked with blade of square and all plumb cuts with the tongue.

Photo No. 4 is a view of the opposite side of the framing square showing attached wood pieces. These pieces are equipped with ball friction catches which ride in grooves routed into top and bottom of rafter. This method holds square securely in place, but allows it to be moved freely.

Photo No. 5 shows the aid set up for practice in rafter layout. Many combination spans and roof pitches can be developed. Information can be given in such a manner that the student must figure the unit rise. For practice layouts use boards made from two pieces of ½ in. by 10 in. by 8 ft. plywood, hinged together end to end, on which strips of white butcher paper are stapled. These boards are later used for practice in stair horse layout.

Photo No. 6 shows the aid being used for tests. The instructor can write in various combinations of test questions.

Photo No. 7 shows aid is being used to help teach an information lesson on the construction of a box cornice including names of various parts. Each piece snaps on separately as the lesson proceeds. Name plates are small boards on wires which fit into holes. Photo No. 8 shows method of fastening pieces.

Photo No. 9 pictures these pieces of cornice, side sheathing, and roof sheathing before being attached.

Photos No. 10 and No. 11 show two different methods of gutter treatment. Comparison of costs can be made during the lesson presentation.

For those who might wish to duplicate this aid use studding, plates, corner posts of standard thickness sections. Rafters are 1 by 6 S-4-S. Span of roof 6 ft., unit rise 8 in.

# OLD STRAIGHTEDGE

## THE DRAFTSMAN

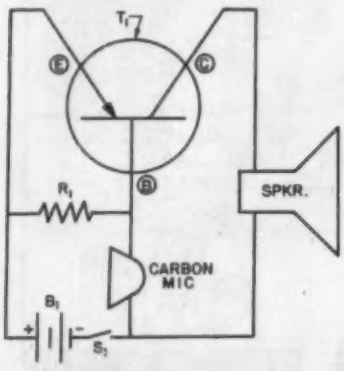
By John D. Springer

STRAIGHTEDGE, HOW ABOUT CHECKING MY DRAWING?
WOW!
STRAIGHTEDGE
PROBABLY THE DIRTIEST DRAWING I EVER SAW!
SMUDGELY, IF YOU'RE GOING TO WORK HERE, YOU HAVE GOT TO LEARN NEATNESS. LET ME SHOW YOU A FEW SIMPLE TRICKS.
REVOLVE PENCIL
BOW YOUR T-SQUARE BEFORE MOVING IT UP AND DOWN BOARD
TRY TO WORK DOWN THE SHEET TO AVOID SLIDING T-SQUARE OVER NEW DRAWN LINES
IF YOU'RE USING A DRAFTING MACHINE..... PICK IT UP!
LEAVE PURCHASED GROUND ERASER POWDER OR THE "FILINGS" FROM NORMAL ERASING ON YOUR SHEET
KEEP TOOLS CLEAN
ANYONE WHO SMEARS A PENCIL DRAWING WITH HIS FINGER SHOULD BE FIRED!
COVER YOUR BOARD.
FOLDING A TRACING IS A SIN, SMUDGELY
I THINK YOU'RE A GOOD DRAFTSMAN, BUT YOU'RE DIRTY!
OLD STRAIGHTEDGE SURE CAN MAKE THINGS CLEAR.

# BUILD A TRANSISTOR MEGAPHONE


**WILLIAM J. RYAN**
Instructor of Electronics
Gloversville, N. Y., Schools

1. REMOVE MATERIAL IN CROSS HATCH
2. FOLD ON DOTTED LINE
3. SPRAY CONE MATERIAL




LEGEND
$T_1$ = 2N242 OR SIMILAR
$R_1$ = 10 OHM ½ WATT ± 5%
$B_1$ = 3 - 7½ VOLTS
$S_1$ = PUSH TO TALK SWITCH
SPKR = 3.2Ω PM SPEAKER

The transistor has brought about a great change in the electronics field. Unfortunately, it is not "boy-proof" or cheap, and this has caused many industrial arts instructors to avoid any projects involving transistors.

This simple megaphone is a practical device making use of the "work-horse" of the semi-conductor world, the power transistor.

Many applications are being found for the power transistor. In some automobile radios they are used for audio output; in some communications equipment they can be pressed into service as d.c. to d.c. converters in the power supply. This megaphone makes use of a power transistor in a high-level audio circuit. In theory, it is a simple voltage amplifier. The carbon microphone impresses a high-level pulsating d.c. directly on the base of the power transistor. The output power of this circuit is high enough to drive a speaker without using an output transformer.

The components in the megaphone are few; a careful shopper can obtain all the parts for under $8. In many cases, some of the parts can be salvaged from old table model radios.

The microphone is a modified surplus T-26 carbon chest unit. The modifications are simply the removal of all mounting brackets and drilling of two ⅛ in. holes in the plastic carbon button holder. It is necessary to bring new leads from the T-26 so use care in the disassembly to note the wiring.

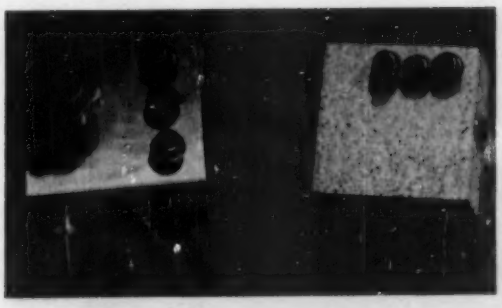
The housing for the megaphone is a two-quart plastic fruit juice container. These are easily obtainable in a supermarket, or perhaps the family kitchen may provide one. The modification will depend on the size speaker being used; however, care should be used to cut the container to the diameter of the speaker after all needed modifications are made.

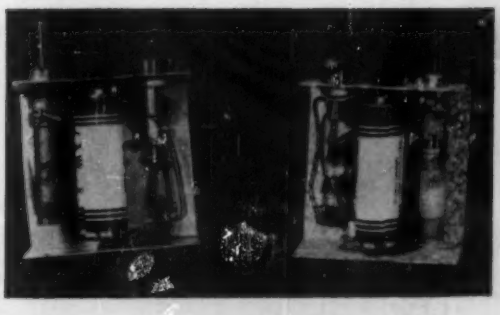
The speaker used is a standard 4 in. replacement type. The modifications consist of stiffening the cone to limit audio response and cutting the frame to adapt it for use in the container. The stiffening process is readily accomplished by coating with spray-type or brushing lacquer. The brackets to mount the speaker are made by trimming away excess metal, leaving tabs at the four corners. These are bent at right angles, two forward and two back, to support the parts of the container.

The wiring is simple — use the schematic as a guide. The power transistor can be mounted directly on the speaker magnet frame. A hole should be drilled and tapped to accept a 6/32 machine screw. The power transistor housing is also the collector; this operation makes the speaker frame common with the collector. All wiring should be done directly to the transistor. Use all precautions to avoid overheating the transistor. If you do not wish to solder on the transistor leads, jiffy connectors can be made from 7- or 9-pin miniature socket prongs.

The switch used is a momentary contact-spring return type. It is mounted in such a manner that it can be operated by the same hand holding the megaphone. The batteries are held in with brackets made of soft aluminum and arranged around the speaker magnet frame. Wiring was made directly to the battery terminal and soldered. A single 3 to 7½ volt miniature battery can be used, provided it meets space requirements.

This simple megaphone is useful around the school, particularly during large group activities. The instructor can teach theory along with procedure for working on and with transistors.





# THREE-TRANSISTOR WONDER


**ROBERT H. BERRY and EDWARD E. LIESSE**

Instructor and Graduate Student in Industrial Education
Purdue University, Lafayette, Ind.


Do you want a three-transistor radio that has baffled the experts because of its simplicity? This radio is simple to construct because no complex circuits are involved. Having a short construction time, the students should not lose interest in the project.

The three transistors used in this radio are of the general purpose type. They are unique in the fact that the collector and emitter characteristics are interchangeable at the low voltage used; therefore, it is possible to eliminate the biasing resistors that are usually found in transistor circuits.

Several types of construction are available for this radio. Two models can be made. One of these models makes use of a variable capacitor with the loopstick to form the tuned circuit, while the other model makes use of a fixed capacitor and loopstick. A third variation involves making the radio in a plastic box which uses the fixed capacitor and smaller penlite batteries due to space limitations. Other chassis modifications might be discovered that would facilitate easier construction in certain situations.

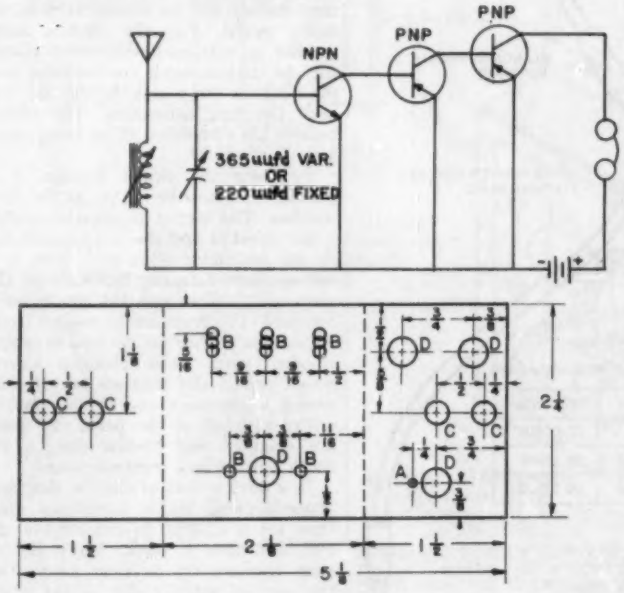
Transistor sockets are included in the two models because of the fact that excessive heat will damage the transistors. By using the sockets a student can connect the circuit, with transistors removed, without destroying the transistors during the soldering operation. In making the plastic box model, a pair of long nose pliers should grip the transistor leads between the transistor body and the solder connection to dissipate the heat caused by soldering.

### Construction Procedure

1. Lay out the pattern on sheet metal as shown in the drawing.
2. Punch or drill holes as marked. (NOTE: Transistor socket holes will be formed by punching or drilling three ⅛ in. holes and filed to the required dimension.)
3. Bend chassis on fold lines.
4. Paint chassis.
5. Install rubber grommets, rivets, and soldering lugs as illustrated.
6. Install transistor sockets. (NOTE: Line all transistor sockets the same way.)
7. Mount pin jacks.
8. Attach capacitor: (*a*) variable — mount in hole provided on chassis, and (*b*) fixed — solder leads across loopstick terminals.
9. Mount loopstick.
10. Wire as per schematic.
11. Make sure all connections are soldered.
12. Place transistors in sockets.
13. Place batteries in circuit, noting polarity.

### Bill of Materials

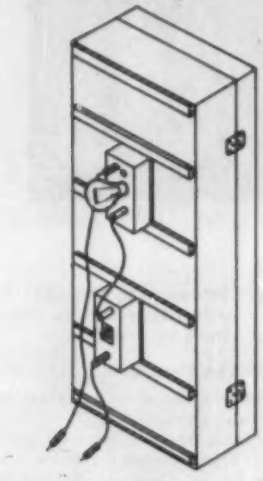
| *Quan.* | |
|---|---|
| 1 | 20–22 gauge sheet metal, 2¼ by 5⅛ in. |
| 3 | Transistor sockets |
| 1 | Antenna loopstick |
| 1 | Single gang, 365 mfd., variable capacitor |
| 1 | 220 mfd., fixed capacitor |
| 2 | Pin jacks |
| 5 | Rubber grommets, ¼ in. mounting hole |
| 4 | Rivets |
| 4 | Soldering lugs |
| 2 | Penlite batteries, 1½ volts, Burgess type Z, No. 7 size AAA for plastic case |
| 2 | PNP transistors, G E 2N107, Raytheon CK 722, Sylvania 2N1235 |
| 1 | NPN transistor, G E 2N170, Raytheon CK 724, Sylvania 2N233 |
| 1 | Pair head phones (2000 ohm impedance) or single 1000 ohm headset |

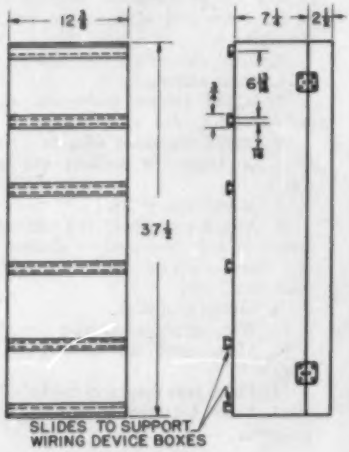


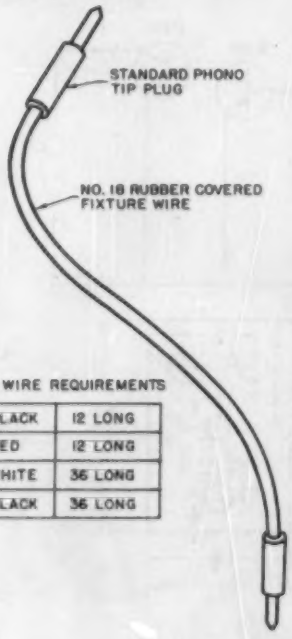
# THE CIRCUIT BUILDER

**ROBERT J. MOUSER**
Instructor of Electricity
Neshaminy High School
Langhorne, Pa.

THE TEACHING AID AT THE RIGHT SHOWS A WIRED CIRCUIT (WITHOUT THE POWER SUPPLY BOX). THIS IS ONE LIGHT BEING CONTROLLED BY ONE SINGLE POLE SWITCH.






JUMPER WIRE REQUIREMENTS

| | | |
|---|---|---|
| 6 | BLACK | 12 LONG |
| 6 | RED | 12 LONG |
| 12 | WHITE | 36 LONG |
| 12 | BLACK | 36 LONG |

For many years, drafting teachers have used models in their classes to make clear to their students those problems that were difficult to visualize and understand. The writer is sorry to state that electric shop teachers have not resorted to this method as eagerly as they might. The electric shop teacher has a chalkboard upon which to draw the circuits. This type of instruction has had poor carry-over value when the students actually attempt to wire the circuits. A few more enterprising electric shop teachers have built all of the circuits on boards to display them for the students for their understanding. This may leave the students confused because they do not see the circuit as it is actually wired. For the electric shop teacher to wire each and every circuit for the student using conventional wiring methods and wiring devices has just been too time consuming. The circuit builder has eliminated all of these problems.

By using the circuit builder, it is possible to build the circuit as the class watches. The circuit is operable within a few minutes and the student watches as the instructor adds each wire in a few seconds. Literally hundreds of circuits are possible with the simple parts involved. The parts are all rugged house wiring types. They are encased in rugged wooden boxes with plexiglas covers which permit the students to view the wiring connections and to become familiar with all of the parts. No parts are dropped and broken due to the shock and impact resistant boxes.

In a novice class of electric shop students, nothing builds confidence more than for a student to construct a circuit and have it work. Many electric shop teachers try to steer away from this sort of activity due to the shock hazard involved. Not so with the circuit builder. It is merely necessary for the shop teacher to substitute the 6-volt bulbs for the 110-volt ones, install a 6-volt battery in place of the 110-volt line cord and let the student start to build circuits without any worry. Operation will be exactly the same as the 110-volt circuit without the danger.

Once the shop instructor has constructed the basic circuit builder case and allied parts for his school shop, there will be no limit to the amount of various circuits he can invent to supplement the basic kit. An entire low voltage set can be developed by building wiring boxes that contain transformers, bells, buzzers, burglar alarm relays, and fire alarm thermostats. The possibilities are limited only by the shop teacher's ideas! These additional components are all housed on the rugged plastic faced boxes and are easily stored in a cabinet or else in another suitcase-type storage kit.

The writer has used the circuit builder in his shop classes for about five years and it has worked very well. It is his sincere hope that others will adopt this modern method of teaching electricity by the construction of this basic electric shop kit, the circuit builder.

**Bill of Materials**
(Wiring Device Box)

| *Quan.* | *Part* |
|---|---|
| 2 | Sign receptable, socket type |
| 2 | Switches, single pole toggle |
| 2 | Switches, three-way toggle |
| 2 | Switches, four-way toggle |
| 1 | Receptable, suplex convenience |
| 1 | Power supply box (see drawing) |

(NOTE: Each box will need 6 phono tip jacks.)

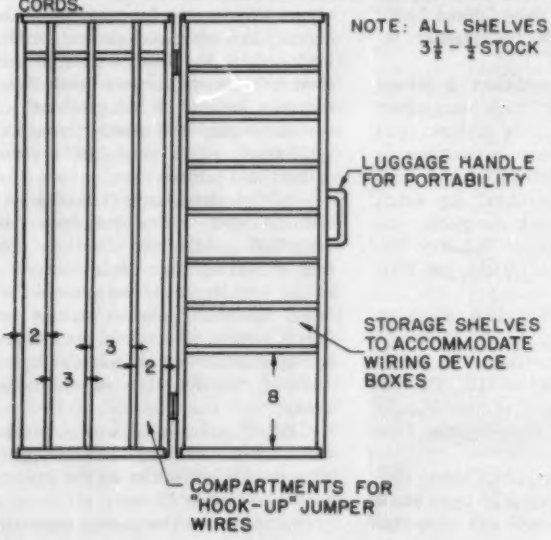
A student removes one of the wiring device boxes (a duplex convenience outlet) from the storage shelves of The Circuit Builder to use in construction of a circuit.

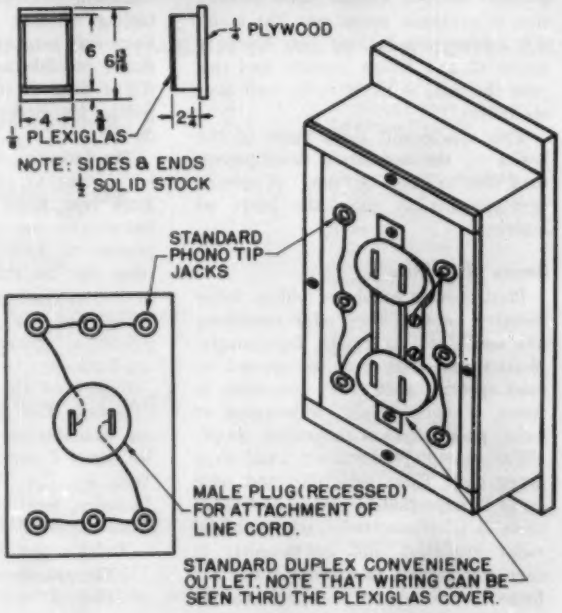
A student tests a job that he constructed: two 3-way switches controlling one light bulb (six volts).

A student hooks up a circuit so that one light bulb will be controlled by one switch. (110 volts)

Interior view of the cabinet showing storage of the wiring device boxes and lamp bulbs.

REAR VIEW OF "THE CIRCUIT BUILDER" SHOWING THE STORAGE SPACE FOR WIRING DEVICE BOXES AND THE COMPARTMENTS FOR THE STORAGE OF "HOOK-UP" JUMPER CORDS.



profiles in industry

A phase of the magnificent world of plastics: Saran film is wound on rollers after extrusion as large air bubble in Dow Chemical Company's Midland, Mich., plant.

▶ the second article in a series of surveys of basic industries, this **report on plastics** provides the basics and history and typical applications of a modern field —

# Plastics

**PAUL HARSHA**
Plastics Section, Public Relations Department
The Dow Chemical Company, Midland, Mich.

Today's plastics products result from one of the most intensive research efforts in history.

In the past quarter century, millions of dollars and hundreds of thousands of research hours have been thrust into the search for new and better synthetic materials. The results have been swift growth: In 1942, United States production of synthetic resins was just under 500 million pounds. Last year it was in excess of five *billion* pounds. And this year the total is likely to be well over six billion.

This article will cover some of the basics of the industry's development, then turn to "case histories" of specific developments to show the range of activity.

**Basics of Plastics**

Plastics have become a billion dollar industry because they offer something new and useful to society. Increasingly, plastics materials can be tailored to meet specific needs. They contribute in terms of light weight, wide range of color, good physical properties, adaptability to mass production . . . and often lower cost. Their versatility and wide range of important properties has placed them in telephone, radio, television and radar insulation and components; in cars and planes, boats and trains; in foamed cushions and in upholstery for furniture; in floor coverings; in shields for translucent lighting, etc.

But communications have tended to lag behind technical progress. Many of the materials are new — and sometimes balky. The technology is complex, the applications far ranging, the participants highly competitive. The handbooks are still being written — and rewritten. New testing methods are being developed. For every established use of plastics, a dozen possible new ones may appear. All of these factors have limited broad public knowledge of the plastics industry.

The industry, nevertheless, is served by several excellent trade magazines. Each year, more schools, colleges, and universities are adding instructions in plastics to their curriculum. And realizing that an informational gap exists in communications with the public, the Society of the Plastics Industry has printed a "primer" on plastics and their applications.

Copies of this illustrated brochure, "Plastics, The Story of an Industry" are available at cost from the Public Relations Committee of SPI. The address is: The Society of the Plastics Industry, Inc.; 250 Park Avenue, New York 17, N. Y.

Today's picture presents more than 5500 companies engaged in some phase of plastics activities — the materials manufacturer, the processor, and the fabricator and finisher. The horizons are broad and promising and the tempo is ever faster.

But what are plastics?

The Society of the Plastics Industry contributes this definition of plastics as man-made materials in contrast to nature's materials like wood and metal:

"Any one of a large and varied group of materials consisting wholly or in part of combinations of carbon with oxygen, hydrogen, nitrogen and other organic and inorganic elements which, while solid in the finished state, at some stage in its manufacture is made liquid, and thus capable of being formed into various shapes, most usually through the application, either singly or together, of heat and pressure."

Some of these same materials — as coatings — play a less well known but nevertheless vital role. Coatings products commonly lose their identity in or on a more easily recognizable material. Essentially, plastics become coatings products when they are designed for application out of a water system (latexes), or out of a solvent system (resins).

Getting quite basic for a moment, there are two major classes of plastics, plus several specialties as the "plastics tree" illustration shows.

One class, the thermosets, consists of

products which once melted and formed into finished shape cannot be remelted. They can be compared to eggs which once cooked cannot again be made liquid.

The other and by far the larger class of major plastics are called "thermoplastics." They can be melted, formed into shape, remelted and reformed again and again. They are similar in this respect to butter.

Plastics originate from very commonplace materials — petroleum, coal, and salt. These basic materials are treated in such a way as to produce intermediate chemicals. Some of these become the building blocks for thermosetting plastics. Others are processed to become monomers — the basic building blocks from which thermoplastics are made.

### Applications Development

To win use, plastics materials have to do a job better than what already is being done.

Most often, this means a team effort — not only in the development of useful materials but in putting them to work in other industries.

As a major plastics raw materials producer, The Dow Chemical Company has more than 150 plastics engineers in its Plastics Technical Service organized in 1943. These technologists travel tens of thousands of miles each year in the spirit of "working it out together" with plastics users. They average nearly a third of their time in customers' plants. In their own laboratories, they work with research, production, and sales on technical problems and literally hundreds of developments touching every industrial field. For polystyrene alone, more than 7000 different uses have been developed.

## a short history of plastics

The Society of the Plastics Industry gives this account of how the industry grew:

No longer than 91 years ago there was no such thing as a commercial plastic in the United States. We had not learned that by combining such basic organic materials as oxygen, hydrogen, nitrogen, chlorine and sulphur, new man-made materials could be created — materials which, through variations in the amount and combination of basic organic and inorganic ingredients, could be made with almost any quality desired in an end product.

In 1868, the first commercial plastic, cellulose nitrate, was created in the United States. It came about when a shortage developed in ivory from which billiard balls were made. John Wesley Hyatt, a determined and inventive young printer, met the need hitting upon the idea of mixing pyroxylin, made from cotton and nitric acid, with solid camphor. Concurrently, in England, development was in progress on the use of pyroxylin in lacquers and in other coating materials.

Called Celluloid, this first American plastic was soon found to have many uses. Colored pink, it was quickly adopted by dentists as a replacement for hard rubber in denture plates. It will be remembered as the material from which wipeclean collars, cuffs and shirt fronts were made and as the window curtains on the early automobiles. The first photographic film used by Eastman was made by Celluloid in the '80's — the first motion picture film in 1882.

Forty-one years were to pass before the plastics industry took its second major step forward. In 1909, Dr. Leo Henrik Baekeland introduced phenol-formaldehyde resins. While others in the field of chemistry had experimented with the combination of phenol and formaldehyde, Dr. Baekeland was the first to obtain a controllable reaction between the two. The first phenolic in this country was given the trade mark, Bakelite, coined from his name.

Dr. Baekeland was also the first to develop techniques for converting this plastic to commercial use. His patents covered the production of a phenolic that could be cast (like marbleized clock bases), a compound that could be formed under heat and pressure (like an electric iron handle), and solutions that could be used in making laminates (like restaurant table tops).

From 1909 to 1926 two more plastic materials were developed — cold molded and casein. Then the tempo of plastics development increased consistently as is evident in the accompanying list which gives the year each plastic was introduced and identifies it with a familiar product for each type of plastic.

Cellulose acetate was the next large-volume plastic to be developed commercially in this country. Launched in 1927, it was available only in sheets, rods and tubes until 1929 when it appeared as a molding material and became the first injection-molded plastic.

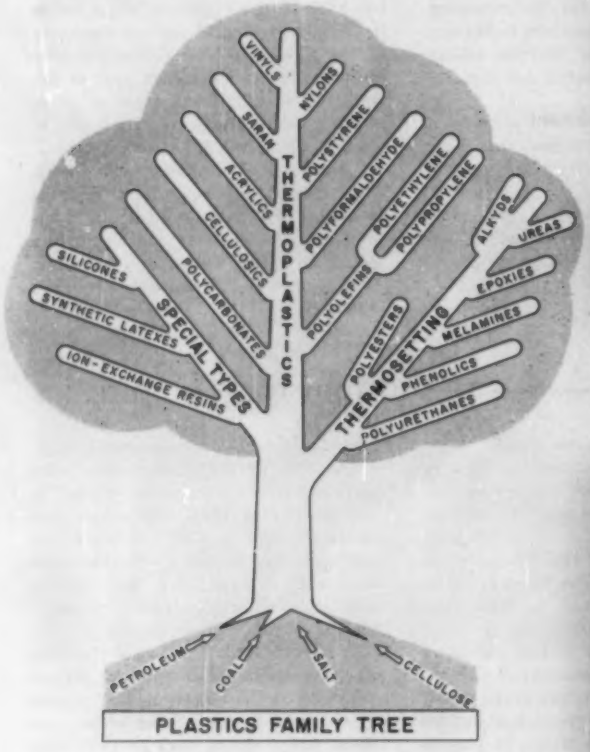
The first of the vinyl resins, polyvinyl chloride, came on the market in this country in 1927. The vinyls now constitute quite a family of resins, the most important of which — besides polyvinyl chloride — are polyvinyl acetate, polyvinyl chloride-acetate, polyvinyl acetals, polyvinylidene chloride.

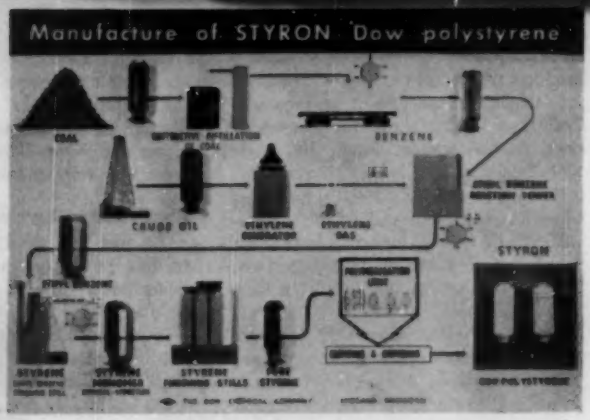
While polystyrene is one of the more recently introduced commercial plastics (brought on the market in this country in 1938) it is one of the oldest synthetic resins, dating back to 1831 when it was first isolated. Today, it is one of the volume plastics, most familiar in toys and housewares.

Both polyethylene and the polyesters were introduced in 1942. Polyethylene, an important insulating material during World War II, was originally produced in England and first produced in the United States for the Navy as electrical insulation. Among other newer materials are acrylics and the urethanes.

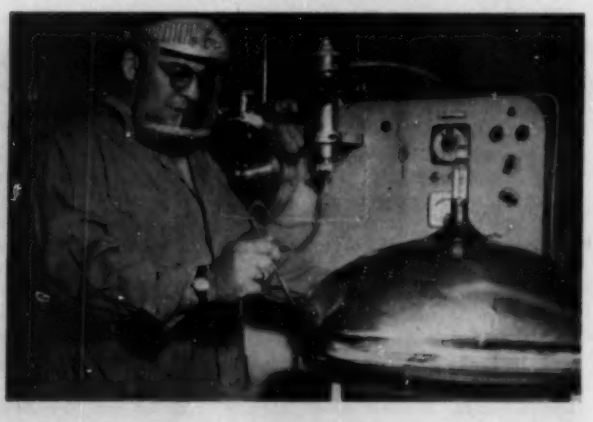
### INTRODUCTION OF PLASTICS RAW MATERIALS

| DATE | MATERIAL | EXAMPLE |
|---|---|---|
| 1868 | CELLULOSE NITRATE | Eye Glass Frames |
| 1909 | PHENOL-FORMALDEHYDE | Telephone Hand Set |
| 1909 | COLD MOLDED | Knobs and Handles |
| 1919 | CASEIN | Knitting Needles |
| 1926 | ALKYDS | Electrical Bases (molded) |
| 1926 | ANILINE-FORMALDEHYDE | Terminal Boards |
| 1927 | CELLULOSE ACETATE | Toothbrushes, Packaging |
| 1927 | POLYVINYL CHLORIDE | Raincoats |
| 1929 | UREA-FORMALDEHYDE | Lighting Fixtures |
| 1935 | ETHYL CELLULOSE | Flashlight Cases |
| 1936 | ACRYLIC | Brush Backs, Displays |
| 1936 | POLYVINYL ACETATE | Flash Bulb Lining |
| 1938 | CELLULOSE ACETATE BUTYRATE | Irrigation Pipe |
| 1938 | POLYSTYRENE or STYRENE | Kitchen Housewares |
| 1938 | NYLON (POLYAMIDES) | Gears |
| 1938 | POLYVINYL ACETALS | Safety Glass Interlayer |
| 1939 | MELAMINE-FORMALDEHYDE | Tableware |
| 1939 | POLYVINYLIDENE CHLORIDE | Auto Seat Covers |
| 1942 | POLYESTERS | Interior Partitions |
| 1942 | POLYETHYLENE | Squeezable Bottles |
| 1943 | SILICONES | Motor Insulation |
| 1943 | FLUOROCARBONS | Industrial Gaskets |
| 1945 | CELLULOSE PROPIONATE | Automatic Pens and Pencils |
| 1947 | EPOXY | Tools and Jigs |
| 1948 | ACRYLONITRILE-BUTADIENE-STYRENE | Luggage |
| 1956 | ACETAL RESIN | Automotive Parts |
| 1957 | POLYPROPYLENE | Industrial Moldings |
| 1957 | POLYCARBONATE RESIN | Appliance Parts |
| 1959 | CHLORINATED POLYETHER | Valves and Fittings |




**Above: an illustration of the many steps in the manufacture of a typical modern plastic. Below: a Dow technician conducts laboratory filling tests on the new 23-in. TV tubes made of a super-strong, clear, bonding resin.**



Expansion during the past 10 years has ranged across the nation, paralleling a trend to decentralize plastics production facilities.

A parallel organization in the coating area, Coatings Technical Service, was organized in 1948 for similar reasons.

Both groups aim to carry an advancing science to the market place.

Following are rundowns on four specific market developments that may provide the teacher insight on the efforts involved to achieve this goal.

### 1. Epoxy Resin and New TV Tubes

The 23-inch TV screen on many 1960 sets marks a major improvement. Engineered to meet customer and industry requests, the new laminated tubes combine the picture bulb and the safety glass into a single unit.

The idea is relatively simple and the compact assembly permits reduction of cabinet size while increasing picture size and clarity. Set designers are freed from the restrictions imposed by the separate safety glass required by conventional tubes and sets.

A stumbling block encountered in development of the new bulb was the lack of a suitable bonding material. A laminate was needed that would give a lasting bond between the tube and safety cap without interfering with picture clarity and quality. The bonding material had to be tough and strong enough to protect viewers from tube implosion, and it had to meet manufacturing and cost requirements.

In its search for the bonding material, Corning Glass contacted major chemical and plastics suppliers without success. No commercial product adequately met Corning's specifications.

Breakthrough came when coatings chemists at Dow set about designing a plastic resin specifically for the new 23-inch bulbs.

A research and development team evaluated existing materials and decided that liquid epoxy resins showed best promise. Three months later an experimental material developed in Dow's Texas Division laboratories passed preliminary tests.

After rigid inspection by the Biochemical Research Laboratory to insure that it passed all tests for human safety, the epoxy was placed in pilot plant production.

Meanwhile, chemists at Midland set up a mock TV tube assembly line to prove to tube manufacturers that the resin was adaptable to mass production.

As a result, the tube and implosion panel assembly laminated with epoxy resin was approved by tube and set manufacturers. The Underwriters Laboratories approved laminated assemblies for safety and the Electronics Institute of America approved the resin system for color.

The resin strength is such that about 15 tons of pull would be required to separate the face panel from the tube. Laminated tubes are unaffected by either high humidity or temperature variations between minus 40°F and plus 165°F. And the optical properties of the resin are identical to those of glass.

Other benefits: TV sets will be considerably slimmer with a larger and more rectangular area. Housewives no longer will have to dust the tube and safety glass so pictures will be sharper.

### 2. Packaging — The Table Ready Container

A plastic cottage cheese container just introduced by the Borden Company looks deceivingly simple. But it took two years of intensive research and testing to bring it to market.

The new table-ready package was developed through the co-operative efforts

(Continued on page 50)

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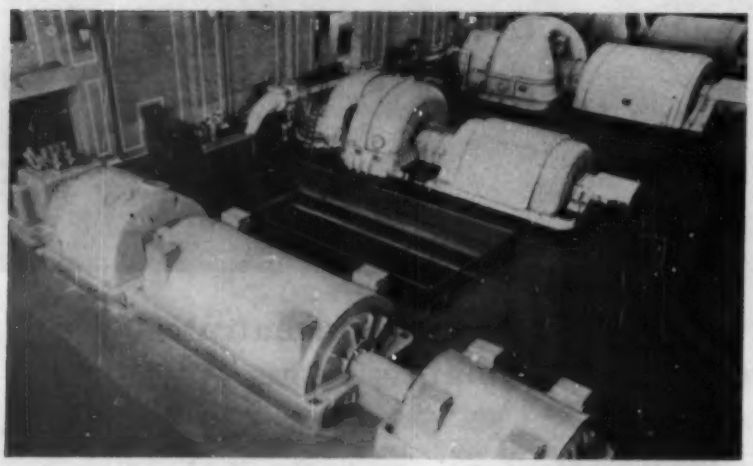
▶ the first in a series of five articles defining basic aspects about our most rapidly emerging and highly important industrial arts instructional area —

# Why Power Mechanics

CHARLES G. RISHER



— General Electric Company

— Boeing Airplane Company

— New York Central Railroad

special report

**power**

Power mechanics is becoming an identifiable industrial arts instructional area. As it develops, greater emphasis will be brought to bear concerning the belief that there is more content to industrial arts than tool usage, material shaping, and project making. That tool usage, material shaping, and project making have been the primary centers of instructional emphasis in industrial arts is evidenced by the numerous books describing shop projects, which concentrate mainly on the tools and materials required for their completion.

If we as industrial arts teachers limit our instruction to the tool usage, material shaping, and project making, we commit a disservice to the students for whose education we are partially responsible. We also commit a disservice to the profession by failing to realize that instructional content sufficient for the preparation of tradesmen in 1880 is tragically inadequate for the general education of an American populace of 1960.

Youth, liberally educated in the industrial arts and prepared to function in today's industrial society, must not only be familiar with tool usage and material shaping, they must also be aware of those other aspects and problems of modern industry which can best be presented in industrial arts classes, but which have heretofore been ignored or neglected.

### An Area of Potential

Of the several areas of interpreted industry previously neglected or ignored, the development of the area of *mechanical power* — its sources, development, utilization, control, transmission and future prospects — gives greatest promise of providing an understanding of mechanized industry from the standpoints of past industrial development, information about today's machines, and a foundation for understanding expected future mechanical developments.

Whether we consider the evolution of powered industry in England, in the United States, or as it has and is developing in Russia, the one factor standing out as primary in industrial development is the steadily progressive application of mechanical power to replace the muscular power of animals and humans. This is evidenced by information published in the United States concerning the development of mechanical power in Russia, the most recent example of a nation experiencing an industrial awakening, by data relating to the increasing development of mechanical power in the United States, and the progressive sub-

**Dr. Risher** is an assistant professor of industrial education at Western Michigan University, Kalamazoo.

stitution of this mechanical power for muscular power.

### Power Development in the USSR

The total capacity[1] of all Soviet electrical power stations was, in 1913 — 1,098,000 kw, and in 1937 — 10,900,000 kw, an increase of 900 per cent.

The total annual output of electrical energy was in 1913 — 1,945,000 kwhr, and in 1937 — 38,000,000 kwhr, an increase of 1800 per cent.

The total output of hydroelectric energy was in 1926 — 3,600,000 kwhr, and in 1934 — 2,123,000,000 kwhr, an increase of 600 per cent.

### Muscular and Mechanical Power in the U. S.

The following table[2] indicates our substitution of mechanical for muscular power.

| | *Animal Power* | *Human Power* | *Mechanical Power* | *Billions of HP — HRS* |
|---|---|---|---|---|
| 1880 | 68.6% | 14.2% | 17.2% | 6.8 |
| 1900 | 51.7 | 10.5 | 38.2 | 31.3 |
| 1920 | 20.8 | 5.7 | 73.5 | 145.0 |
| 1940 | 6.4 | 3.6 | 90.0 | 260.4 |
| 1960 | 1.3 | 2.4 | 96.3 | 471.6+ |

The Russian figures were published in the United States during a period of United States-Russian co-operation, World War II, and prior to "cold war" propaganda. Although they are not current, the figures clearly show that the period during which Russia began its rise to a place of industrial prominence coincided with the period during which this nation was steadily increasing the amount of mechanical power available for industrial production. The fact that Russia's industrial development paralleled the increase of mechanical power was not a matter of coincidence is made apparent by the steadily increasing amount of mechanical power produced in the United States during the past 80 years and the advancing substitution of mechanical power for muscular power.

With an understanding of the significance of applied mechanical power as the controlling factor in industrial production, it becomes axiomatic that a steadily increasing volume of industrial production is more dependent upon an available source of applied mechanical power than upon the availability of raw materials or production tools. It might be said that mechanical power, raw materials, and production tools represent the corners of the production triangle. If the question were asked, "Which corner is the most important?", the answer would have to be *mechanical power*. Mechanical power and raw materials can produce tools. Raw materials can be brought to a source of mechanical power and production tools. But without mechanical power, raw materials and production tools are useless. This concept should serve to develop the importance of mechanical power as an area of industrial arts instruction.

[1]Vinter, A. V., *Twenty-five Years of Power Development in the USSR*, The American Russian Institute for Cultural Relations with the Soviet Union, New York, 1943.

[2]Dewhurst.

### Facets of Content

If a mechanical power area of industrial arts were to be fully developed it would include, among other ramifications: (1) each of the various energy forms. (2) the development of the energy forms into various types of power. (3) the historical development of each type of power. (4) methods of utilization, distribution and control of power. (5) transmission, measurement and future prospects of power, and (6) the social and economic problems involved, etc. This presents a picture so overwhelming that a teacher might be reluctant to begin. All these may be the development toward which we should strive as the area progresses.

### Tools, Equipment, and Space

The beginning of a mechanical power area must not only be within the capabilities of the teacher, but also must be adaptable to the tools, equipment, and space available in an industrial arts laboratory. Such a beginning may be made by the initiation of a *Power Mechanics* area as a part of a general shop program.

Essentially Power Mechanics deals with small two-stroke and four-stroke cycle gasoline engines. The type of engines powering lawnmowers, chain saws, carts and garden tractors, as well as outboard motors.

The raw material for a Power Mechanics area — small gasoline engines — comes from two major sources. They may be purchased directly from manufacturers, or be recruited from students. This last should prove a good source since 7,652,000 power lawn mowers were sold in 1958 and 1959. The same thing applies to outboard motors of which 5,845,000 were in use at the end of 1959. The ingenuity and imagination of the teacher plays just as important a part of Power Mechanics as it does in any other area.

As instructional media, these engines provide the bases for a practical study of the operating principles, adjustment, testing, repair, maintenance, and storage of small gasoline engines. A Power Mechanics area provides for more than instruction in how to disassemble and assemble an engine, or how to prepare an engine for storage. It considers the more important, but less tangible, aspects of instruction such as why an engine functions in a particular way; how the ignition system functions; why an engine is given specific treatment when it is prepared for winter storage; why there is a specific procedure for through-the-week storage of an outboard motor; or what treatment must be given a recovered outboard motor after submerging.

**look for the second part of this series on power mechanics (on what should course content be?) in your IA/VE for December . . .**

### The Physical Product

As it might be suspected, the physical product of a Power Mechanics area can hardly be a project in the traditional sense of the word. If a physical project is desired for purposes of evaluation, the decision as to what it will be must remain with the individual teacher. It is to be hoped that the most important product of a Power Mechanics area is a student, better informed as to certain applications of power; how it is developed, controlled, transmitted and measured; and what the prospects are for the continued use of this power form. All these would be difficult to embody in a traditional type of project.

Before a teacher of Power Mechanics makes the decision about a project as such, he might do well to investigate the physical outcomes of laboratory instruction in other subject matter areas to see what visible products of instruction are used there.

We have for many years considered the quality of "Yankee mechanical ingenuity" to be an inborn trait of above average mechanical ability unique in Americans. Unfortunately this is a fallacy. Mechanical ingenuity can result only from experience with machines and machinery. This experience coupled with an active imagination produces this "Yankee mechanical ingenuity" so zealously sought. That mechanical ingenuity actually exists, and is not a myth or legend, is evidenced by the large sums of money American industry pays to its employees, not engineers, for new solutions to old production problems.

Power Mechanics is not *the* solution to a technically oriented population, but it is one more approach. Power Mechanics is an evolving instructional area devoid of many time-honored guide posts. Its development will depend upon imagination and ingenuity. Its subject matter content is firmly based in American industry, and it is an approach to industrial arts which can emerge as one of the strongest and most educationally meaningful instructional areas of the industrial arts. ◀

## ASSOCIATION NEWS

(Concluded from page 8)

Leaders are to protect a group, kindle new fires, and put out some of the existing fires. He displayed a gavel symbolizing control and close cooperation in a group such as this. "So put on your pilot's hat, steer the ship, and know that you have a lot of people working with you. The stakes are high and you are going to get there."

Dr. Clifford Dobson, Department Head, Industrial Arts Education at Los Angeles State College, and past president of C.I.-E.A. next spoke on "Leadership Tools on Parade."

Most important tools are human relations, organization, programming, meetings, abilities, communications, hard work, cooperation, feed back, records, and ideas. Dr. Dobson stressed that, "it was nice to be important, but it's more important to be nice." The organization should be democratic. A program with effective meaning should be developed. The abilities of the people within the organization should be exploited to the fullest. Involving people is the key to success in any organization. Learn how to communicate facts and ideas and how to visualize your presentation. The leader must set an example by working hard so that those about him will also work equally as hard. Cooperate but don't lead too far. Remember, others are following. Be a good listener and sensitive to the other fellow's reactions, ambitions and desires. Any conference or meeting must have accurate records. Other tools of leadership include writing ability, speaking ability, problem solving and trouble shooting ability.

Luncheon was held at the Hudson House and the speaker was Lyman Goldsmith whose topic was "ZGHAYGHTES" (symbol of speech). He stressed that the most important quality of leadership is the ability to speak or communicate. Have your presentation well planned and deliver it with sincerity. Recipe for a good speech was given as follows: (1) add a good idea, (2) add to this illustrations, (3) spice with interest, (4) blend well, (5) pour into a mold, (6) bake into warm personality, and (7) serve in a direct and correct manner.

In the final analysis it was felt that blessed is the leader who is humble, who knows how but does not discourage. United we stand, divided we fall.

Mr. Ed Parodi, vocational educational director, Teacher Training College, Normal School, Lima, Peru, special guest, stressed the stratified society in his country and that human relations were non-existent there as compared to those in this country.

Richard Nelson, supervisor of technical and industrial education, State Department of Education, summarized and evaluated the morning and afternoon sessions at the close of the conference.

He said that it was important to provide an opportunity for planning and leading discussion groups and conferences to promote professional growth within the ranks of industrial educators; to provide industrial educators with information of the latest trends in supervising and administration, industrial education programs as related to industrial education association.

He pointed out that we should question whether the job fits the persons available in the organization; do we accept new ideas or help to create new ideas; are we finding ways of getting leadership through service as apprentice. Mr. Nelson stressed that the women should not be forgotten.

The record, in the form of a booklet, is being prepared and will be available within the near future.

This second annual conference resulted from a pilot meeting in Santa Monica in May of 1958 when the program was originally developed.

## COMING CONVENTIONS

*Oct. 27–28 Oklahoma Industrial Arts Association,* at Oklahoma City University, Industrial Arts Bldg., Oklahoma City, Okla. Secretary, Cary L. Hill, Oklahoma State University, Industrial Arts Education, Stillwater, Okla.

*Nov. 3–5. Iowa Industrial Education Association,* at Hotel Savery, Des Moines, Iowa. Secretary, Leonard Bengtson, R.R. 2, Nevada, Iowa.

*Nov. 4–5. Kentucky Industrial Education Association,* at Kentucky Hotel, Louisville, Ky. John D. Rowlett, associate professor of industrial arts, Eastern Kentucky State College, Richmond, Ky.

*Nov. 10–12. Industrial Arts Conference,* at Hotel LaSalle, Chicago, Ill. General chairman, Dr. Verne C. Fryklund, president, Stout State College, Menomonie, Wis.

*Nov. 10–12. Oregon Industrial Arts Conference,* at Benson Polytechnic High School, Portland, Ore. Secretary, Miss M. Hallock, 546 N.E. 12th Ave., Portland 12, Ore.

*Dec. 4–7. American Technical Education Association,* at Biltmore Hotel, Los Angeles, Calif. Secretary, William N. Fenninger, 22 Oakwood Place, Delmar, N. Y.

*Dec. 5–9. American Vocational Association,* at Biltmore Hotel, Los Angeles, Calif. Secretary, M. D. Mobley, 1010 Vermont St., N.W., Washington 5, D. C.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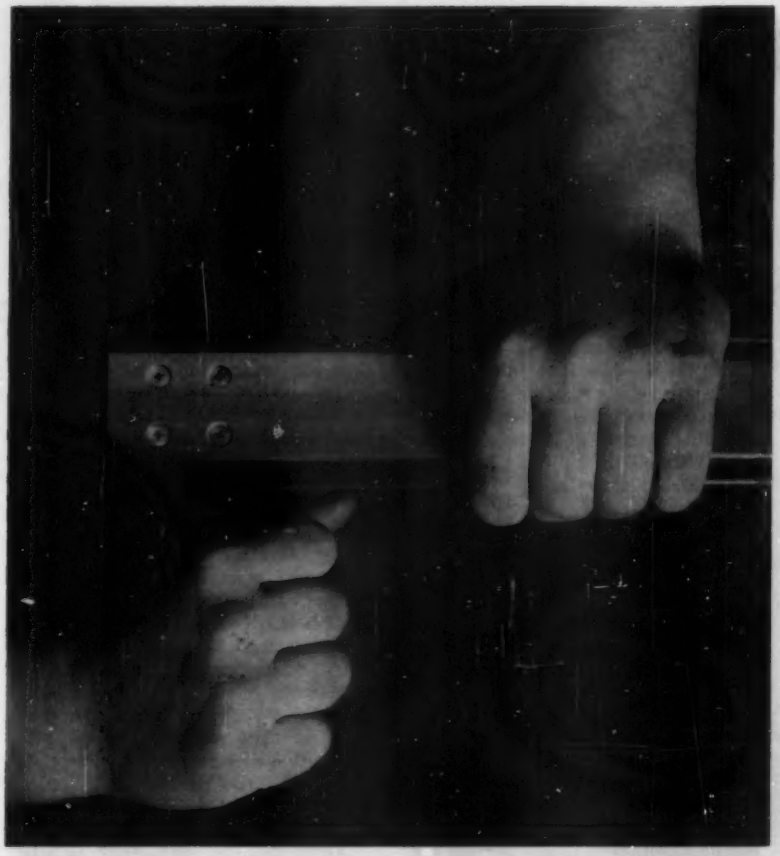

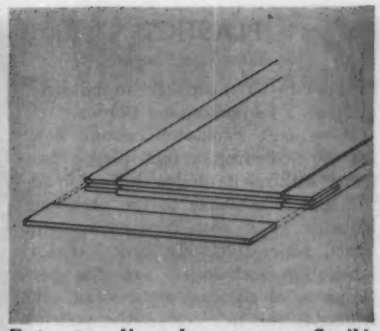

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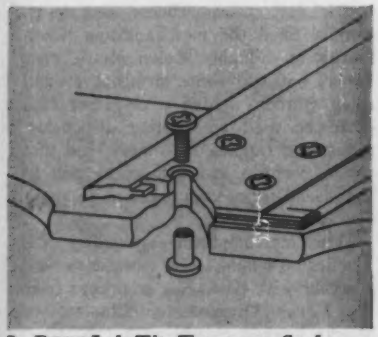

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POST

## PLASTICS

(Continued from page 44)

of a raw material supplier, an industrial designer, a fabricator, and Borden.

It is most significant because now, for the first time, a rigid plastic container with all its design and color advantages is available to the packaging industry at a cost competitive with waxed paper tubs. Mechanical design, fabrication techniques, and the performance of the raw material all contribute to this new competitive position for plastic packaging.

At the start of the project, The Dow Chemical Company was approached by Borden which was considering using plastic for cottage cheese containers. Borden liked the merchandising possibilities of a highly styled plastic container, but laid some stringent ground rules. Borden wanted a container that could be used on existing dispensing, filling, and capping machinery, and that would perform and protect as well as the waxed paper containers at competitive packaging costs.

Dow merchandising specialists and Plastics Technical Service engineers, together with packaging engineers from the Conex Division of Illinois Tool Works worked closely with the industrial design firm Trombley, Pisani and Trombly to develop a container prototype that was both aesthetically appealing and carefully engineered to allow for substantial weight reduction.

The result is the container with a fluted daisy petal design being introduced by Borden.

The fluted design serves both styling and mechanical functions. It promotes identification with the Borden daisy and adds column strength to the container, making it more rigid.

Much of the mechanical design was contributed by Conex, which joined the development team in the early stages.

The rolled lip, which adds extra rigidity to the top of the container and allows the lids to be removed more easily, and a nesting shoulder built into each container to allow them to nest without jamming are patented Conex developments.

Another patented Conex development is a controlled vent in the lid which allows trapped air to escape after capping to reduce internal pressure, thus eliminating bulging or distortion of the lid, an important stacking feature.

The containers are pressure formed from sheet extruded from Styron 475B, high impact polystyrene made by Dow.

According to the fabricator, their patented pressure-forming process provides greater dimensional accuracy than is possible with vacuum-forming techniques. They explained that the plastic conforms to the mold better, giving greater detail. Higher lusters are easier to attain through pressure forming, they added.

Conex said the most significant reason for using thermo-forming techniques as opposed to injection molding is that they allow thinner walls while still maintaining good physical properties. Much higher production runs are also possible, contributing further to the containers' competitive cost position.

Since the old package used either metal or paper lids, the cost of the plastic lids compared with previous lid costs proved competitive.

With the new plastic container, metal lids were ruled out because they could cause stress cracking. Paper was also inadequate because as it absorbs moisture it changes size and could cause distortion according to Conex.

— Dow Chemical Company

**A pigment grind for an experimental paint made with Dow Latex is being put through a Morehouse Mill.**

According to Borden, the new package meets its requirements admirably. A few minor adjustments enabled Borden to use existing equipment. The shelf life of the new package is substantially improved. The new package is competitive in cost with older packaging materials.

### 3. Plastics in Automobiles

The dream of a plastic automobile body has been greatly tempered as the technology of plastics grows. Success is measured today in tenths of a pound. With present materials, the all-plastic body is generally considered unfeasible.

But the automotive industry is an important market for plastics and will become even more important in the future. The use of molded thermoplastics in 1960 models averages six pounds per car. Plastics engineers believe this will more than double by 1963 to 15 pounds per car — a 90-million pound annual market in three years.

The Dow Chemical Company, as a raw materials manufacturer, is approaching this market in two ways.

Plastics Technical Service engineers try to tailor particular Dow materials to do jobs presently being done by other plastics . . . but at a lower cost.

A number of 1961 models attest to the success of this approach. Zerlon, methyl methacrylate/styrene copolymer made by Dow, will be used in dial faces on GMC trucks, Chevrolet Corvairs, and Studebakers. This is an application that was traditionally held by acrylic because it had been the only plastic with adequate weathering characteristics and clarity.

Because Zerlon performs adequately at a lower price it has gained access to the market in the order of a million pounds a month.

The other way Dow approaches the automotive market is to target a particular area of application presently being held by one of the more conventional materials.

PTS determines the engineering requirements of the target application, produces a prototype of the part and then goes into the field to work with automotive engineers and fabricators to prove that the particular application can be produced more economically in plastic.

Air conditioning ducts, fresh air inlet butterfly valves and valve bodies, heater distribution ducts, steering column cover plates, and hot air deflector grills, all traditionally metal stampings or "gunk" moldings, are now being made of Styron 440, high heat, high impact polystyrene.

Advantages in cost, design flexibility, corrosion control, and weight reduction all contributed to the acceptance of this material.

Another success story to support the "target" strategy is Chrysler Corporation's use of Ethafoam, Dow's new polyethylene foam, for gasketing materials.

Ethafoam is moisture and dust resistant, has desirable rigidity, low friction, high compressibility, excellent ozone resistance, and is clean to handle. These qualities are helping it get a share of the body gasket seal market, previously held by foam rubber.

Ethafoam has increased from a half-dozen applications for gasket material in the 1959 and 1960 Chrysler Corporation line of cars to more than 30 applications in the 1961 models.

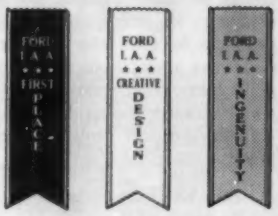
Like other plastic applications, cost advantages combined with adequate performance helped break the ice.

Other areas of application that Dow expects to gain a share of the business will be arm rest bases, taillight lenses, and kick panels.

(Concluded on page 52)

# CONGRATULATIONS I.A.A. WINNERS!

**To the 640 students who won cash prizes . . . and to all 4,000 students and teachers who participated in the 1960 Industrial Arts Awards program, Ford Motor Company extends its congratulations!**




The 1960 Industrial Arts Awards Competition was a display of pride of workmanship and rare skills . . . evidenced by an abundance of creativity, ingenuity and resourcefulness in projects. Winning projects exemplified the freshness that has characterized this competition since its inception. Congratulations once more to all the participants!

Here are the 32 I.A.A. Outstanding Achievement Award Winners in 1960!

| STUDENT • CITY | TEACHER • SCHOOL | DIVISION | PROJECT |
|---|---|---|---|
| EMMETT COLBERT, 17 • Phoenix, Ariz. | C. J. Johnson • West High School | Graphic Arts | printing process, a book entitled "The History and Romance of the Pistol" |
| JAMES CARY, 14 • Altadena, Calif. | Roy Bredin • Charles W. Eliot Junior High School | Architectural Drawing | model beach home |
| JAMES W. LESTER, 18 • Long Beach, Calif. | B. H. Palmgren • David Starr Jordan High School | Architectural Drawing | working set of plans for a residence |
| ROY NAKAGAWA, 14 • Gardena, Calif. | Gus Barlow • Peary Junior High School | Graphic Arts | display folder on President Wilson |
| GERRY RUSSELL, 13 • Culver City, Calif. | J. Harvey Seiple • Palms Junior High School | Electrical | transistorized intercommunication unit |
| WAYNE SASABE, 15 • Los Angeles, Calif. | Walter E. Thompson • Thomas Starr King Junior High School | Models | 36" model racing yacht, constructed with seven layers of pine lumber |
| ROBERT D. SHONYO, 18 • San Leandro, Calif. | Nicholas Saba • San Leandro High School | Electrical | a "picture and pattern" video generator |
| JAMES T. STEWART, 14 • San Diego, Calif. | Donald H. Stansifer • Dana Junior High School | Electrical | Tesla coil |
| STEVEN GAMBLE, 14 • Miami, Fla. | Marvin J. Willis • Ada Merritt Jr. High School | Woodworking | hand-made violin, bow and case |
| FRANK JOHNSON, 18 • Chicago 49, Ill. | Robert P. Urchel • Chicago Vocational High School | Graphic Arts | printed letterhead, envelope, invoice and calling card |
| TOM TIERNEY, 13 • Joliet, Ill. | John Hickman • Washington Junior High School | Electrical | elaborate electrical control panel |
| DAVE BEARDEN, III, 17 • Wichita, Kan. | L. C. Bork • Wichita High School East | Electrical | ten-room fire alarm system |
| KENT EDWARD PARRETT, 17 • Prairie Village, Kan. | Chauncey Gorsage • Shawnee Mission East High School | Architectural Drawing | a model of a three-wing contemporary ranch-type home with three patios |
| JOHN S. CHUCKRAN, 17 • Brockton, Mass. | Donald O. Drew • Brockton Trade High School | Woodworking | maple dining room set |
| JOSEPH R. COPPOLA, 18 • Beverly, Mass. | Robert J. Tate • Beverly Trade School | Patternmaking and Molding | wood pattern for core box machine housing |
| FRED AGEMY, 13 • Highland Park 3, Mich. | Thomas L. Harrison • Willard School | Woodworking | mahogany bowl |
| DAVID FAUSCH, 17 • Morristown, Minn. | Urban Anderson • Central High School | Models | scale model of a steam engine |
| ROGER EDWARD NEAFUS, 17 • West St. Paul, Minn. | Curtis M. Johnson • Sibley Senior High School | Electrical | AC arc welder with welding manual and working drawing |
| DAWAYNE PETERSON, 15 • Osseo, Minn. | Lee Gresser • Osseo High School | Plastics | fiberglass duck boat |
| SIDNEY JOHNSON, 18 • Staples, Minn. | Michael J. Matanich • Staples High School | Machine Shop | compound sine plate |
| THOMAS A. CIAMPI, 15 • Newark, N. J. | Bruno W. Piefke • Essex County Vocational-Technical High School | Machine Shop | adapters for milling machine spindles |
| PETER A. GOEGL, 17 • East Orange, N. J. | Bruno W. Piefke • Essex County Vocational-Technical High School | Machine Shop | shop microscope used for checking surfaces on machine tool parts |
| MICHAEL KUROWSKI, 17 • Newark, N. J. | W. A. Morgenroth • Essex County Vocational-Technical High School | Machine Shop | universal indexing fixture |
| WAYNE BURGESS, 14 • Greensboro, N. C. | David A. Rigsby • Woman's College Training School | Woodworking | mahogany poster bed with canopy |
| CHARLES PERRY GOODRUM, 13 • Greensboro, N. C. | David A. Rigsby • Woman's College Training School | Woodworking | Duncan Phyfe spinet desk |
| DAVID W. JOHNSTON, 15 • Greensboro, N. C. | David A. Rigsby • Woman's College Training School | Woodworking | cherry slant-top desk |
| LARRY WILLIAM JONES, 18 • Greensboro, N. C. | David A. Rigsby • Woman's College Training School | Woodworking | set of bedroom chests |
| G. DONALD COOK, 18 • Ardmore, Pa. | William Loeliger • Lower Merion Senior High School | Architectural Drawing | plans for a junior-senior high school including plot plan, floor plan, cover sheet, roofing plan, and two elevations |
| ROBERT DERINS, 13 • Philadelphia 24, Pa. | Alphonse S. Zimba • Thomas Creighton School | Open Division | an M-1 rocket with detailed description and breakdown of components |
| RUBEN ANZALDUA, 17 • Harlingen, Tex. | C. C. Owen • Harlingen High School | Leather | western-style hassock, with deerskin top |
| BARBARA HOWARD, 17 • Harlingen, Tex. | C. C. Owen • Harlingen High School | Ceramics | set of thrown ceramic pieces: lamp, bowl, and rice bowl |
| LEE JONES, 19 • Washington, D. C. | Rufus Jacoby • Calvin Coolidge High School | Wrought Metal | sterling silver pitcher and matching stirring spoon |

**FORD MOTOR COMPANY**



*(For more information from advertisers, use the postcard on page 75)*

## PLASTICS

(Concluded from page 50)

Ethocel, Dow ethyl cellulose, has been approved as an alternate material for arm rest bases by the Fisher Body Division of General Motors. Extensive testing of Zerlon for taillight lenses and park and turn light lenses is being conducted by one of the big three and is expected to result in that material's acceptance.

Linear polyethylene is being used for seat side shields and kick panels by Ford and American Motors. Dow recently came on stream with the first two of a planned linear polyethylene series and can expect to share in this business.

Dow's approach to the automotive market is consistent with marketing trends in many plastics markets. The company is attempting to tailor its products to meet the requirements of particular applications in the packaging and refrigeration industries, as well. A trend toward design for use is now evident and will probably continue to grow.

### 4. Thin Shell Construction Techniques

Free-flowing "thin shell" roofs are in demand and being used increasingly by architects throughout the world.

Such construction allows for unlimited architectural freedom as well as two definite building advantages: (1) the roof may be erected first with a bare minimum of vertical supports, providing protection and cover for exterior wall construction and interior decoration, and (2) large areas may be spanned without intermediate vertical supports by roofs requiring an economic minimum of construction materials.

However, in the United States, widespread use of thin shell roofs has been hampered by the high labor and material costs of elaborate form work and supports.

Engineers of Purdue University and The Dow Chemical Company, in a joint project, set out to find a way of eliminating much of this form and support structure.

A proposed answer was announced this year after two years of research: Use foamed polystyrene plastic planks "to create the desired surface previous to and act as a support for the application of the structural roof material."

The plastic form boards are bent to the desired roof contour. They serve in a triple capacity: as a form for the permanent roof, as thermal insulation, and as an effective vapor barrier.

In a Purdue structural engineering laboratory, engineers erected a 20 by 20 foot hyperbolic paraboloid (saddle shaped) thin shell roof. The large scale model was constructed by use of lattices of wires over and under the plastic foam which created the desired hyperbolic paraboloid shape. A Purdue Research Foundation report described it as "a fresh approach to lid-building."

The report, in the May issue of "PRF Horizon," also says:

"Results of all tests performed on the experimental model indicate that this is a highly satisfactory, relatively simple and inexpensive technique for providing large unobstructed spaces under a graceful and attractive roof structure."

Plans are under way to build a 30 by 30 foot hyperbolic paraboloid roof with a weatherproof concrete surface on the Purdue golf course.

Dow plastics engineers said the same concept will be used in elliptically-shaped elevated concourses at the new Trans-World Airlines Terminal at Idlewild International Airport. The architect is Eero Saarinen, of Bloomfield Hills, Michigan.

At Midland, Michigan, Architect Alden B. Dow is using the concept in a service station roof.

Meanwhile, the Purdue research group has turned its attention to adaptations of the construction method for other shaped structures. Dr. Joseph L. Waling, of the Purdue Civil Engineering School, is in charge of the research.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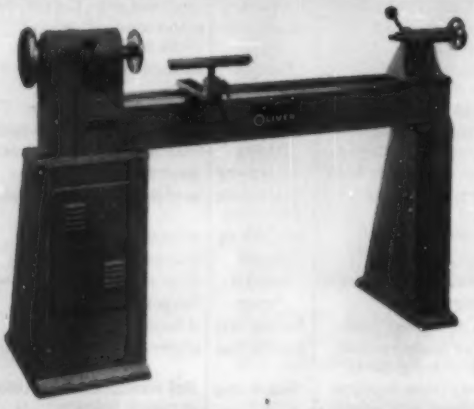

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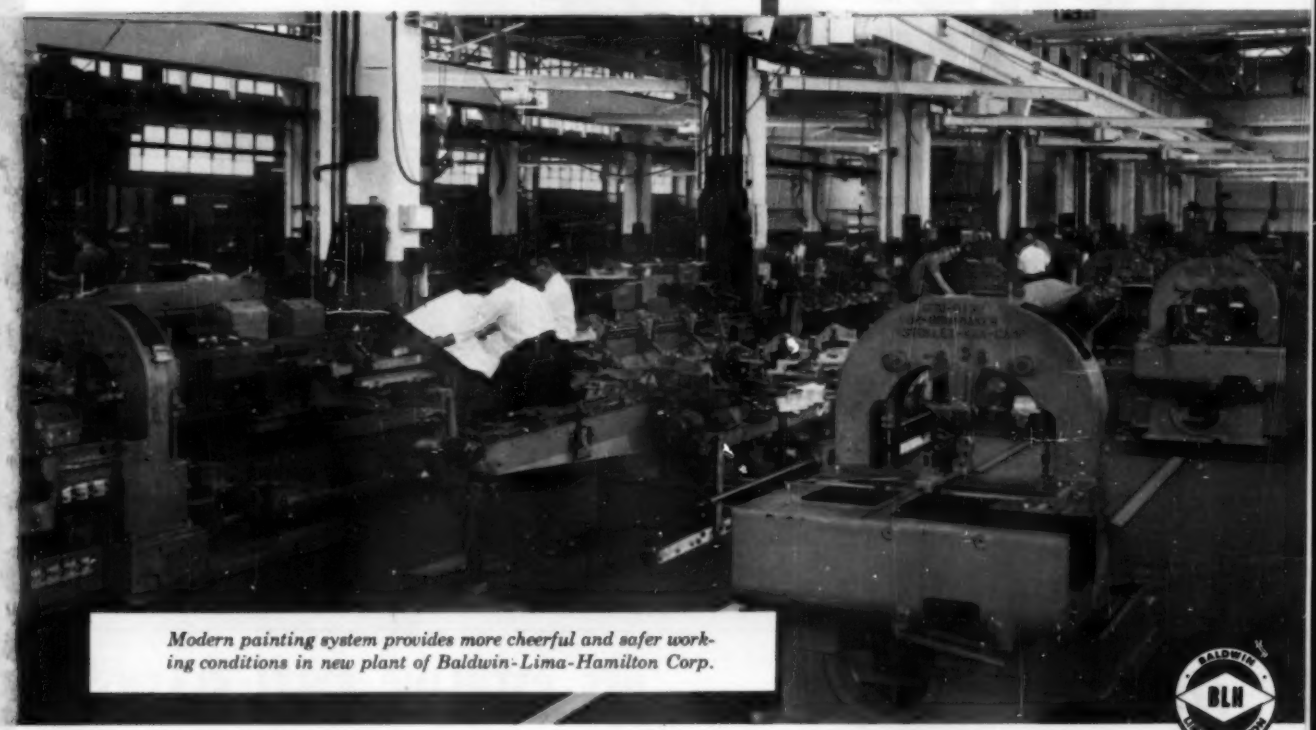

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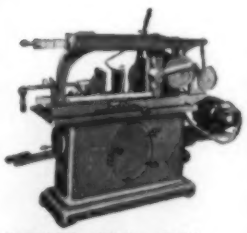

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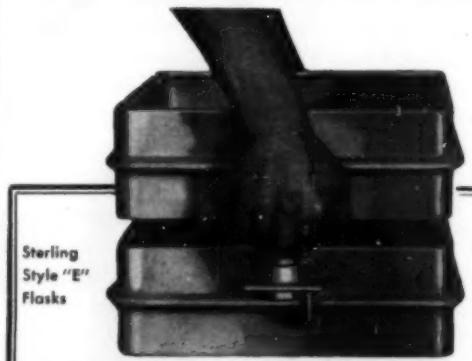

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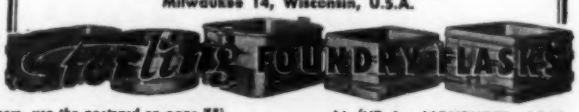


# personal

**awards . . .**

▸ *Ewald Turner,* industrial arts teacher from Pendleton, Ore., was elected vice-president and president-elect of the National Education Association at its Los Angeles convention in July. He will take office as president in 1961.

▸ *S. Wayne Taylor* is the newly elected president of the International Graphic Arts Education Association, the professional association of graphic arts teachers. Mr. Taylor is director of the University of Houston's printing plant and is associate professor of journalism and graphic arts at the school.

**appointments . . .**

▸ *Albert R. Squibb* has been named supervisor of industrial arts for the Ohio State Department of Education at Columbus to succeed the retiring P. S. Waldeck (see "retirements," below). Mr. Squibb received his bachelor and master degrees from Ohio University at Athens where he has been an instructor for the past four years. He is a member of EPT, Phi Delta Kappa, and the OIAA and AIAA.

▸ New staff members at the State University of New York College for Teachers at Buffalo, N. Y., are:

*Stanley Kasprzyk,* who formerly taught in public schools of Pennsylvania and Maryland, will teach courses in graphic arts; *Lee H. Smalley,* formerly teacher in the Iowa and Michigan public schools, and Michigan State University at East Lansing, now supervisor of student teaching at Buffalo; *John P. Loree,* who had been a teacher in adult education classes at Hornell, N. Y., is teaching ceramics courses at Buffalo; *Clifford R. Johnson,* formerly a teacher in public schools at Seneca Falls, N. Y., will teach woodworking classes at Buffalo; and *Gilbert J. Gimbel,* who will teach mechanical drawing courses, formerly taught in Syracuse, N. Y., public schools and also developed a drafting program for apprentices at General Electric Corporation in Syracuse.

*William Bowers, Howard Meyer,* and *Rex Miller* of the Industrial Arts Education Division were promoted to associate professors.

▸ *Paul H. Sales* as assistant professor of the Mechanical Engineering Department at Wentworth Institute at Boston, Mass. In this position he will be in charge of mechanical drawing in the first year at the Institute. His past experience includes teaching industrial arts at Edward Everett Junior High School at Boston, and as head of the industrial arts department at Billerica High School in Massachusetts and also at Adams Center Central High School in New York; he was also head of the mechanical drawing section at West Babylon Junior-Senior High School at Babylon, N. Y., and in 1959, he was appointed senior instructor at Brooklyn Polytechnic Institute.

**retirements . . .**

▸ *P. S. Waldeck,* state supervisor of industrial arts, Department of Education, Columbus, since 1946, whose retirement became effective on September 30, 1960. He received his B.S., in 1930 and his A.M., in 1932 from Ohio State University. From 1923–26 he was a teacher in the public schools of Lima, Ohio, and from 1926–42 he taught in the public schools of Columbus. He served as Lieutenant Commander in the U. S. Navy from 1942–45. He became state supervisor of industrial arts with the Department of Education in 1946.

Mr. Waldeck is a member of the Ohio Education Association, and the Ohio Industrial Arts Association having served as chairman in 1940; and holds memberships in Epsilon Pi Tau, Phi Delta Kappa, and Sigma Delta Rho.

▸ *Daniel J. Crowley,* whose retirement from full-time teaching in the department of industrial arts and engineering drawing at Bowling Green State University, Bowling Green, Ohio, became effective August 1, 1960, after 41 years of service. He was for many years head of the department, and was an outstanding leader in his section of the country, as well as a member of the Mississippi Valley Conference.

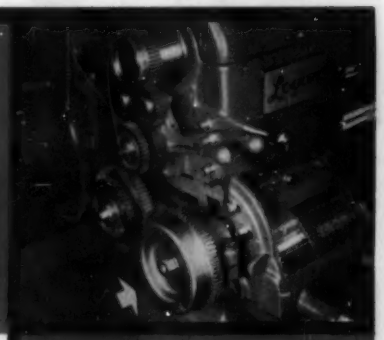
**teacher activities . . .**

▸ *H. J. Gerber,* formerly assistant professor and head of the machine shop department at Oklahoma State University, Stillwater, Okla., has resigned his position to further his studies toward his doctorate.


# new safety feature

Logan

Automatic Safety Gear now standard equipment on 10" and 11" models



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Model 1875
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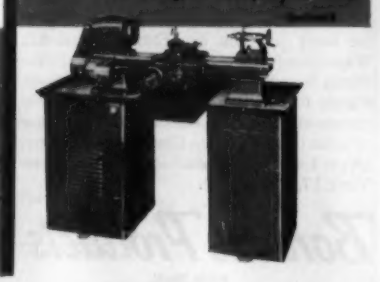

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# notebook

## A GUIDE TO STEEL ALLOYS

One of every ten pounds of steel* made in this country is alloy or stainless steel. The importance of alloy steel is vital in twentieth-century industry. Atomic reactors, jet airplanes, or rocket motors could not be made without steel alloy.

The United States is well supplied with the raw materials — iron ore, limestone, and coal — to make carbon steel. But among the ingredients necessary for alloy steel — nickel, chromium, and manganese — all must be imported from other countries.

Iron as a pure metal is not strong enough to be used for tools, machines, beams, etc. With a small amount of carbon, however, it becomes extremely tough in the form called carbon steel. There are other elements comprising this metal, including manganese and silicon, for carbon alone cannot give steel all the properties demanded by modern industry, such as the ability to harden to a greater depth or to resist rusting or corrosion. But whatever is added, almost every type of steel, whether carbon or alloy, must be treated either by heat or by working to achieve maximum qualities.

Three of the most important types of furnace used are the open hearth furnace, the electric furnace, and the Bessemer converter. Elements added to the steel will determine the type of furnace used.

Steels to which special elements have been added to produce certain properties are called stainless or alloy steels. They contain enough chromium to insure their resistance to corrosion. A steel with more than 3.99 per cent chromium is called a stainless steel. The added elements are known as alloying elements. They are found as crude ores mixed with earth, sand, or rocks, from which they must be separated before they can be used. They must then be refined and purified for the desired alloying elements. Sometimes these are added to the steel as pure metals, but more often in the form of ferroalloys.

Ferroalloys are solid mixtures of iron with chromium, manganese, or silicon. They are called ferrochromium, ferromanganese, etc. In most ferroalloys, the iron content is less than 50 per cent. For instance, ferrochromium is 65 to 72 per cent chromium.

The percentage of the special element contained in ferroalloys is very different from that in the finished steel. For example, a ferroalloy of manganese used in making high-manganese steel contains about 85 per cent manganese, but the resultant high-manganese steel is only 14 per cent manganese.

### Alloying Elements in Steel

Below are listed the 12 principal alloying elements, together with sources, common uses, etc.:

1. *Boron* (B) is added to intensify the degree of hardening, that is, the depth to which a steel can be hardened by heat treatment. It may be used in very small amounts (as little as 0.0005 per cent) and still reduce the number and amount of costly other elements that would be needed to attain the desired result. It thus makes possible the conservation of nickel, chromium, or molybdenum. Boron may be added as ferroboron, with 10 to 24 per cent boron, or in the form of ferroalloys containing other elements as well. Boron is obtained from borax and is plentiful in Western United States. Typical steel products produced with the use of boron are machinery parts, dredges, power shovel buckets, and diesel-engine crankshafts.

2. *Chromium* (Cr) is important in many grades of alloy steels and necessary in all stainless and heat-resisting steels. Chromium-bearing steels are used in the production of tools and machinery. Small amounts improve hardening qualities; larger amounts improve resistance to corrosion. Chromium is added to molten steel as ferrochromium. The principal sources of chromium are Turkey, the Philippines, Southern Rhodesia, and Cuba.

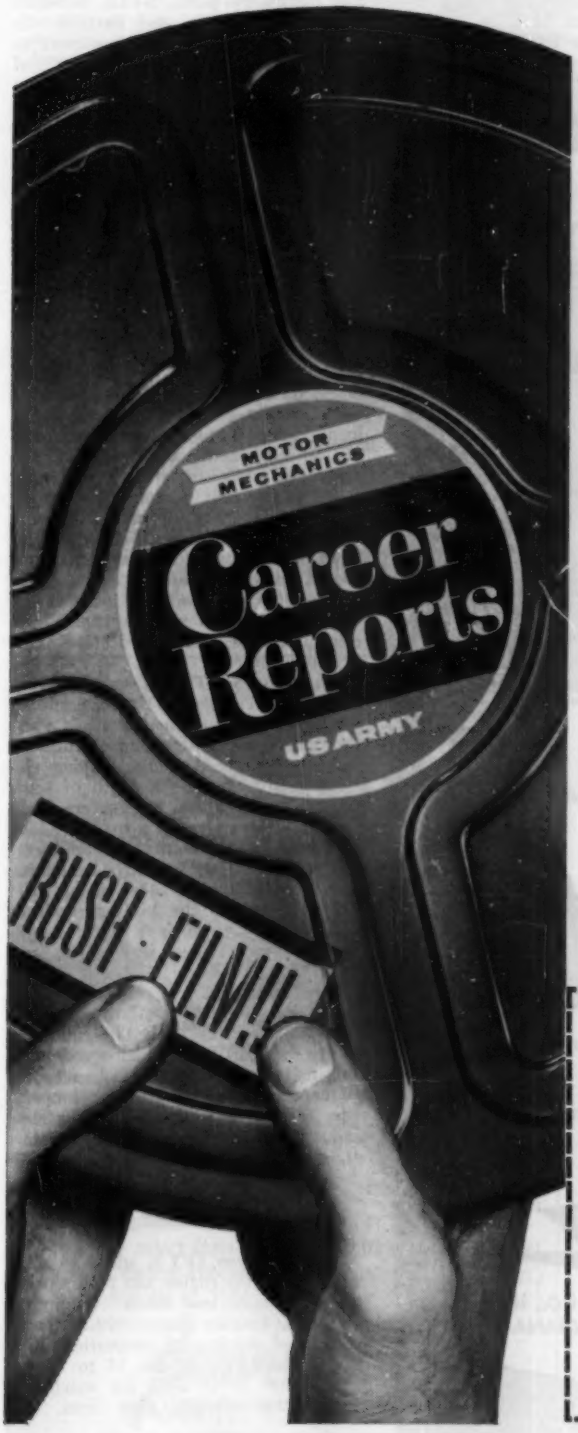
3. *Cobalt* (Co) is used mainly as an alloying element in magnet steels and permanent-magnet alloys, for severe high-temperature service, and for tool steels that hold a cutting edge at high temperatures. It is also used to put a hard surface on parts of equipment that must resist wear. It is added in the form of 97 to 99 per cent pure metal. Its principal sources are Canada, Northern Rhodesia, French Morocco, and the Belgian Congo.

4. *Columbium* (Cb) or Niobium (Nb) is used to increase the strength of some of the "super-alloys" for severe high-temperature service. It is also used to prevent undesirable changes in the structure of certain stainless steels when they are used at high temperatures or welded. Columbium, relatively scarce, is usually added in the form of ferrocolumbium 50 to 60 per cent pure. It is used for boilers, tubing, turbines, jet engines, and chemical skills. Principal sources are Nigeria, the Belgian Congo, Belgium, and Canada.

(Continued on page 58)

*Adapted from the booklet, "Principal Alloying Elements in Steel," published by the United States Steel Corporation.

# To help you guide the seniors who don't go on to college

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## STEEL ALLOYS

(Continued from page 56)

5. *Copper* (cu) is used, in very small amounts, to retard rusting. Always added as pure metal or as copper-bearing scrap, it is used chiefly for roofing and siding sheets and plates. Its principal sources are the United States, Canada, and Chile.

6. *Manganese* (Mn), one of the most important alloying elements used in steel-making, increases strength and toughness when used in small quantities (1 to 2 per cent). In quantities of 12 to 14 per cent, it greatly increases toughness and resistance to wear and abrasion, desirable for such things as military helmets. It is added in the form of ferromanganese ranging from 78 to 85 per cent pure. Small amounts are present in all steels, but 12 per cent or more is found in railway frogs and switches and dredgebucket teeth. Principal sources are India, Ghana, Union of South Africa, Cuba, and Brazil.

7. *Molybdenum* (Mo) improves hardening qualities and resistance to shock. It is used to increase high-temperature strength in many alloys for high-pressure pipe and steam lines, in certain tool sheets and in a few stainless and heat-resisting steels. Also used in super-alloys designed for high temperature service, it is usually added as molybdenum trioxide ($MoO_3$), and sometimes as calcium molybdate ($CaMoO_4$). Many steels for military purposes contain Molybdenum, either alone or in combination with other alloying agents. It is also used for tools, machinery parts, tubing for airplane fuselages, and ball bearings. Its principal source is the United States.

8. *Nickel* (N) is one of the most important alloying elements and is used widely in stainless and heat-resisting steels for high-pressure pipe and steam lines, and in alloy steel for automotive and machinery parts. Nickel increases toughness, strength, and ductility. In large amounts, it increases resistance to heat and acids. It is used in the form of metal of about 99 per cent minimum nickel content, as sinter containing 75 per cent nickel or sometimes as nickel oxide. Nickel has been scarce (several new steels have been developed as substitutes) and is used, in addition to those already named, for tools, pressure vessels, armor, oil-drilling tools, gears, and ball bearings. Its principal source is Canada.

9. *Silicon* (Si) is primarily an alloying element in steel for electrical equipment. It improves the magnetic characteristics of steel. A new type having directional magnetic qualities (grain-oriented silicon steel) makes possible more efficient electric transformers. Silicon is added as ferroelectric transformers. Silicon is added as ferrosilicon. The low-silicon grades of ferrosilicon contain 10 to 17 per cent silicon and the high-silicon grades 25 to 95 per cent. Silicon, after oxygen, is the most abundant element in nature and is an important constituent of the mineral part of earth. Found everywhere in sand and rocks, it is used for dynamos, transformers, and electric motors. The United States is its principal source.

10. *Titanium* (Ti) is used to prevent undesirable changes in the structure of stainless and heat-resisting steels when they are used at high temperatures or welded. Also used as an alloying element to increase the strength of some of the "super-alloys" for severe high-temperature service, it is usually added in the form of ferro-titanium with carbon, or sometimes in alloys containing aluminum, silicon, or other metals. The United States is the leading producer of this element, which is used for boilers, tubing, turbines, jet engines, and stills.

11. *Tungsten* (W) is added to steel to increase hardness and toughness at high temperatures. It is used in many tool steels, particularly high-speed steels for metal-cutting tools and in some "super-alloys" for severe high-temperature service. It is supplied to the steel industry in the form of ferrotungsten, tungsten powder, and tungsten salts. It is used for high-speed cutting tools and magnets. Its principal sources are China, South Korea, Portugal, Bolivia, and Brazil.

12. *Vanadium* (V) is added to some alloy steels for engine and motor parts, and to many tool steels to improve their heat-treating characteristics, toughness, and mechanical properties. It is added as ferrovanadium 35 to 55 per cent pure. It is used for machinery parts, high-strength pipe lines, and

(Concluded on page 60)


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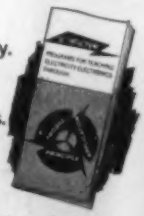

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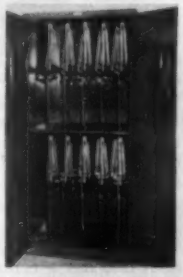

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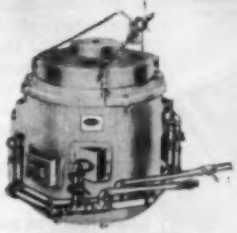

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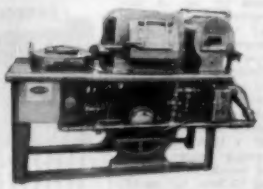

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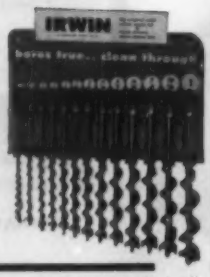


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## STEEL ALLOYS

(Concluded from page 58)

springs. Principal sources are the United States, Peru, and Northern Rhodesia.

### Mechanical Properties of Steel

Mechanical properties are the characteristic responses of material to applied forces. These properties fall into five broad categories:

*Strength* is the ability of a material to resist applied forces. Bridge girders, elevator cables, and building beams all must have this property.

*Hardness* is the ability to resist abrasion (in cutting tools, files, and drills), and penetration (in armor plate, crushing machinery, and metal rolls for steel mills).

*Elasticity* is the ability to spring back to original shape. Auto bumpers and all springs have this quality.

*Ductility* is the ability to undergo permanent shape changes without rupturing. Modern deep-formed auto bodies and fenders, washing machines, and other stamped and formed products are made possible by this property.

*Toughness* involves both strength and ductility; it is the ability to absorb mechanically applied energy. Toughness is needed in railroad car and automobile axles, hammers, rails, etc.

Most steels have these properties to some extent; it is the degree to which each one has a certain quality that determines the best type of steel for each application.

### Magnetic Properties

Magnetic properties of steel are those involving reactions to magnetic or electric forces. Some steels are attracted by magnets, some are not. Certain high-carbon and alloy steels will retain magnetism and are used to make permanent magnets. The degree of each property in the steel must be studied to determine which steel is best for each use. Anti-magnetic steels are used in watches that can be worn near electrical equipment; silicon steels can be made to have directional magnetic qualities. Such steels are used for laminated cores of transformers and in electric motors. In both cases, this directional property increases equipment efficiency.

### Chemical Properties

Chemical properties of steel pertain to its resistance to corrosion and oxidation. Corrosion resistance may be measured in chemical tests for suitability for a specific purpose. Field tests measure corrosion resistance under actual service conditions: in chemical plants or when exposed to fresh or salt water, various oils and weather, etc. Panels of steel samples are exposed to chemicals or to various atmospheric conditions for different lengths of time. The samples are studied to find out which type of steel is best for each condition encountered.

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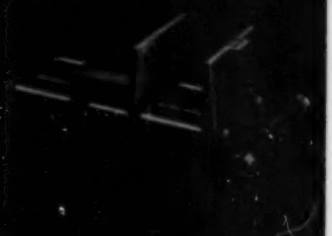

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# new books

### Automotive Mechanics

By William H. Crouse. Cloth, 760 pp., 6¼ by 9¼ in., illus., $6.48. McGraw-Hill Book Co., Inc., New York 36, N. Y.

This fourth edition includes improvement over the integral content and a few effective innovations in the presentation of the matter that make the book more readable for the student as well as more teachable.

The most recent information about new models has been included; sentences and paragraphs that were shortened and clarified to help the student in the third edition have been further clarified and simplified. Changes were made at the suggestion of classroom teachers who use the textbook.

Important points are emphasized by the use of a second color throughout the book, a factor which also improves the eye appeal of the text considerably.

Illustrations are included in the proportion of about one to a page for all the pages (746) treating the subject matter.

### Aerospace Dictionary

By Frank Gaynor. Cloth, 260 pp., 6¼ by 9¼ in., $6. Philosophical Library, Inc., New York, N. Y.

This book is fit for Flash Gordon fans and scientists alike. It explains all the terms and abbreviations used in modern scientific space exploration, from Cape Canaveral to mesosphere.

It also contains an interesting introduction by Werner von Braun pointing out the need for space travel.

### Industrial Electricity, Vol. II

By Chester L. Dawes. Cloth, 573 pp., 6¼ by 9¼ in., illus., $7.50. McGraw-Hill Book Co., Inc., New York, N. Y.

This third, revised edition of Volume II is a textbook intended for courses in some technical high schools, technical institutes, junior colleges, and for college courses for nonelectrical engineering students. It is suited for those in industry and in the Armed Forces who are pursuing self-education.

The book develops in a simple manner the principles of alternating currents and circuits and applies them to industrial applications such as measurements, electrical machinery, power transmission, electronics, and rectifiers.

In the third edition terminology, definitions, and symbols are presented in accordance with the latest ASA standards. Several chapters have been revised to include new developments, and there is an additional section entitled "Motor Classification." Almost all illustrations are entirely new, showing the most modern equipment and practices.

### Anatomy of Lettering

By Russell Laker. Cloth, 94 pp., $6.50. Viking Press, New York 22, N. Y.

This is a revision of a book, first issued in 1946, which has become a favorite text among lettering students who want to master the principles of the design of the Latin alphabet. The present edition accepts the widespread use of san serif alphabets in modern advertising and general printing, but the author is still in love with the classic Roman alphabet and its italic and boldface modifications. Later chapters take up pen lettering, Old English script lettering, and modern face style scripts. The student who heeds the author's insistence on the mastery of letter construction, right spacing, and equal color, should become a successful and understanding letterer.

### The Student Planning Book for Industrial Arts and Vocational Classes

By Gerald B. Baysinger and G. Harold Silvius. Fourth edition, paper, 46 pp., 8½ by 11 in., illus., 80 cents. D. Van Nostrand Co., Inc., Princeton, N. J.

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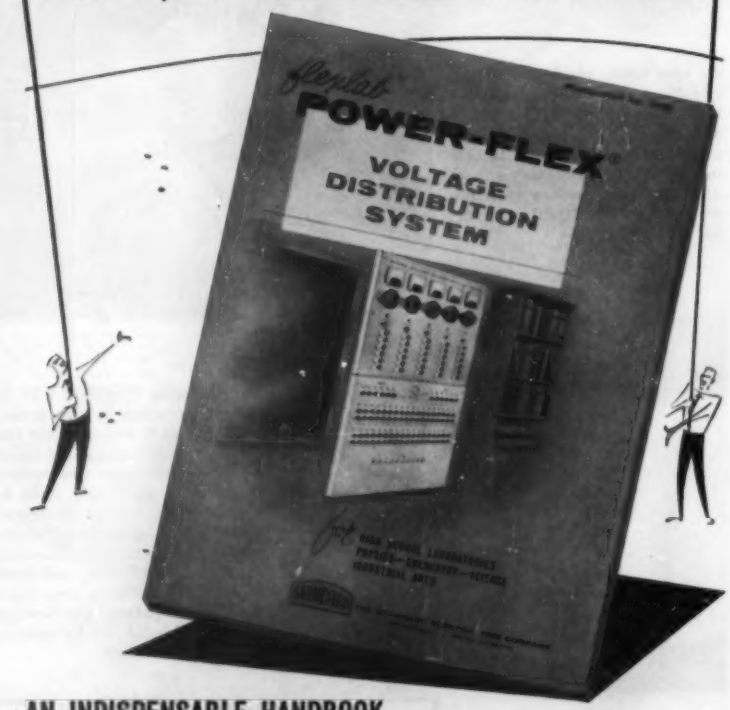


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Now ARMSTRONG deep throat "C" Clamps have the new (Pat. apd. for) ARMSTRONG Ball-joint Swivel Pad. This "C" Clamp pad, developed by ARMSTRONG Engineers, is tougher than any on the market. Rigorous testing in our own plant first proved this fact, and field tests in factories throughout the country have confirmed our own test results.

The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

This wall of steel makes it impossible for the pad to come off the screw during normal use. In fact, our tests have proved that it is virtually impossible to intentionally knock the pad off with a hammer—yet the pad is free to swivel through an arc of approximately 40°.

### Call your ARMSTRONG Distributor

Your ARMSTRONG Distributor can offer delivery from stock on this "400-Series" deep throat, drop-forged "C" Clamp with the new Ball-joint Swivel Pad. He also carries in stock the other styles of clamps in the ARMSTRONG Line—the broadest line of drop forged "C" Clamps.

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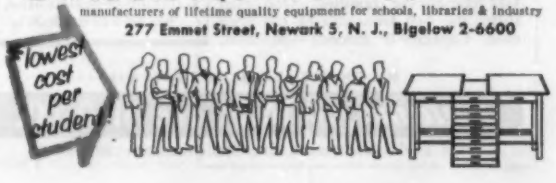




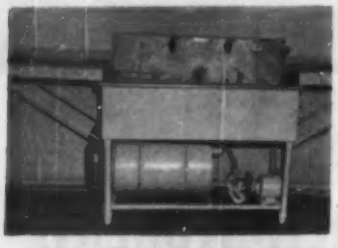

(For more information from advertisers, use the postcard on page 75)

# capsules

## SOLVING A FARM SHOP CLEANUP PROBLEM

Every teacher who teaches units in farm (or other type of) machinery should have a parts washer. We were tired of the inconvenience of fussing with a variety of buckets, pans, etc., and associated fire hazards. The additional problem of what to do with used solvent was always present. Down the floor drain, in the sink, or almost out the door were not satisfactory answers. At times the dismissal bell might ring before proper disposal was made and the uncovered containers were left for teacher cleanup.

The parts washer in the accompanying photograph was our answer. The school had recently undertaken an improvement project, and we fell heir to a double tub galvanized metal sink. The other important parts needed were a 15 gallon barrel, a washing machine pump, and a ¼-h.p. split-phase, electric motor. A combination of standard chrome and galvanized fittings drain the commercial solvent from the tubs to the storage barrel. We placed a ¾-in. cut-off valve between the outlet on the barrel and the pump. This enables us to close off the supply of solvent when it is necessary to repair the unit, regulate the volume of flow, and/or drain the pump.



A piece of black ¾-in. plastic hose carries the solvent from the pump up behind the parts washer to a ½-in. pipe to which the faucets are connected. Since the photograph was taken, we have attached two 2-ft. lengths of clear plastic hose to the faucets to help prevent excessive splashing of the solvent, as well as giving a means of directing the flow on the parts. A milking machine hose works very well.

This parts washer is as fireproof as any that you might purchase. Steel construction is used throughout, the sink can be stoppered, and the electric motor is controlled by a plastic switch (see photo, lower left). Additional safety features are the use of a safe solvent and a fire extinguisher.

This parts washer has worked very well for us. It has solved the problems mentioned earlier in this article. In addition, it has several advantages over the commercial product, other than that of cost. Several students can use it at the same time, and it has drainboards as well.

If you decide to build your own parts washer, we would like to suggest one thing that will save you a lot of grief, discouragement, time, and added expense. That thing is to avoid the use of rubber in any part of your washer, especially in the pump.

**Allan L. Utech**
**Vocational Agriculture Instructor**
Community Unit Schools
Cambridge, Ill.

## WELDING AID

How often have you wished for something to hold a part in place while you weld? A search through your attic, basement, or garage might uncover some items useful in your school shop. This article was once a desk lamp used many years ago, today it acts as an extra hand for a welding student. Simply weld a small vise-grip plier or C clamp to the lamp neck; in this case a small coil clamp made of ¼-in. mild steel rod was made for the job. The knuckle joints provide excellent adjustment features that enable a welder to hold the work in any position. There is always a need for a fixture of this kind in every welding shop. An accompanying photo reveals one of the many ways we use it in our school shop.

If an old desk lamp cannot be found, a similar fixture might be constructed. Some students might like to make it for a shop project and keep it for their own personal use.

**Andy Maggio**
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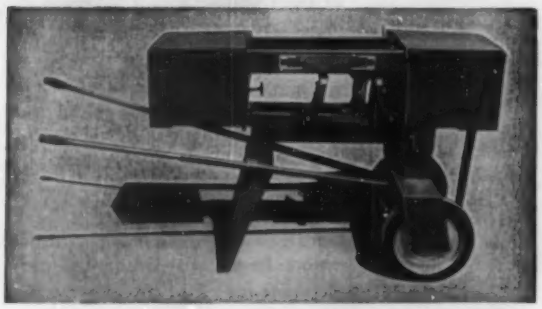

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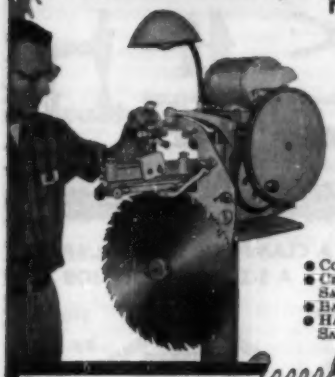

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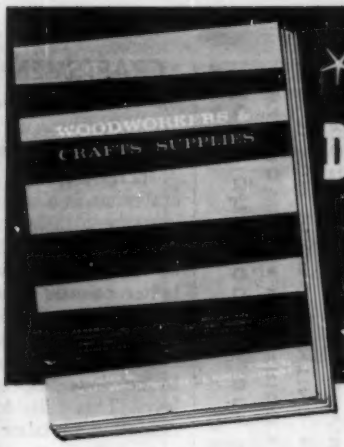


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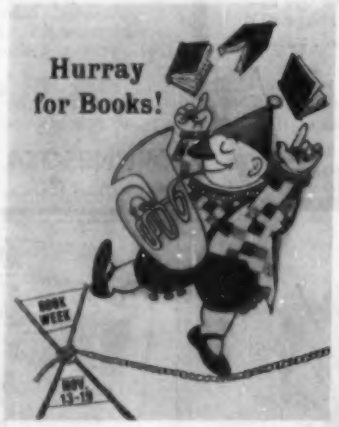
## CRAFTSMEN SHORTAGE

(Concluded from page 19)

### More Co-operation Needed

Increasing the supply of skilled craftsmen is a crucial problem which must be attacked at national, state, and local levels. Much has been done at the national level to bring about better co-ordination of effort on the part of the Bureau of Apprenticeship and Training and the U. S. Office of Education. Much remains to be done, especially at the local level. This calls for the active participation of labor and management representatives working as advisory committees with school personnel and BAT representatives. Local needs must be identified and programs established for the promotion and recruitment of young people to enter both public vocational courses and apprenticeship programs. In many places expanded and new facilities must be provided for in-school preparation. Additional training opportunities must be made available in industry.




Vocational school personnel must recognize their special responsibilities for bringing this urgent need to the attention of labor, management, and others who can lend assistance. Existing advisory committees should be alerted to the problem, and, where needed, new committees formed with this as first order of business.

"The development of our skilled work force is . . . not just something for the future. . . . It is the future . . . the future of our industrial operations, and thus largely the future of our nation and our people."[1]

[1]From an address by C. L. Cornell, Electrical Coordinator, the Ingalls Shipbuilding Corporation, Pascagoula, Mississippi, at the Southern Regional T & I Conference, April 1957.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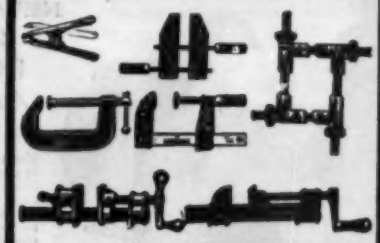

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## NEWS

(Concluded from page 10)

**master course in electronics** The Cleveland Institute of Electronics is offering a new master's course in electronics for established technicians. Developed over a two-year period, the course is intended for men with a sound foundation in electronic fundamentals who want more specialized knowledge to keep pace with the expanding technical developments in industrial electronics and radio and television. The Institute reports a climbing demand by industry for trained electronic technicians. Average starting rates are about $5000 a year for jobs that are in plentiful supply.

**UM conference** The University of Michigan has released the 1960–61 schedule of conferences and institutes for teachers of vocational education and practical arts subjects. University units involved are the Extension Service; Department of Wood Technology in the School of Natural Resources; the Departments of Engineering Graphics and mechanical Engineering in the College of Engineering; the University School and the Department of Vocational Education and Practical Arts in the School of Education. Conferences are: for teachers of Woodwork, Nov. 19, 1960; of General Shop, Feb. 25, 1961; of Auto Mechanics and Driver Education, Mar. 18, 1961; and Drafting and Machine Shop, Mar. 25, 1961. Additional information may be obtained from Dr. Ralph C. Wenrich, chairman, department of vocational education and practical arts, University of Michigan, Ann Arbor.

### surveying the school scene

- In the recent debate on political issues, Senator Kennedy said he supported federal aid for education to be given to the states for classroom construction and/or teachers salaries as the states saw fit, while Vice-President Nixon, who agreed that "we need more pay for teachers," suggested the way to this would be to support legislation for school construction by way of funds for debt service. Mr. Nixon also urged grants for aid to vocational education, libraries, adult education, and schools for the handicapped.
- American Education Week will be observed November 6–12. President Eisenhower, in his proclamation, urged parents to study the programs of the schools and to demonstrate their support of dedicated teachers.
- The integration picture in the Fall of 1960 reveals that the U. S. Supreme Court has moved to step up desegregation in Houston, Tex., New Orleans, La., and Roanoke, Va. In New York, N. Y., the board has announced a policy that will no longer regard neighborhood barriers to pupils seeking admittance to schools on the part of Negro and Puerto Rican students.

**government machinery to district school** The Staples, Minn., Area Vocational School opened Sept. 12 as the only school district plant in the nation utilizing Defense Department-donated machinery and tools. The first of 62 machines so released under a new phase of the National Equipment and Reserve Program will make the Staples Vocational Machine Shop the largest and most thoroughly equipped in the United States. The value of the machinery delivered to Staples — one of three schools in the country selected for the new program and the first in operation — is estimated at almost two thirds of a million dollars.

**graphic arts scholarships** Information on the 1960–61 Printing and Publishing Industry National Scholarship Program is available from the sponsoring National Scholarship Trust Fund, Education Council of the Graphic Arts Industry, Inc., 5728 Connecticut Ave., N.W., Washington 15, D. C. The annual program is intended for high school seniors and graduates "interested in management and scientific, engineering, and teaching careers in the printing and publishing industry."

**fall conference** The Eighth Annual Ball State Industrial Arts Conference convenes at Ball State Teachers College on November 12. The principle speaker will be Dr. Delmar W. Olson, Kent State University, who will discuss the conference theme, "Improving Design in Industrial Arts."


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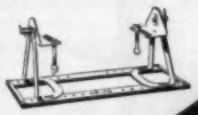

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**(For further details encircle index code 0901)**

## new 17-in. drill press

From Delta Power Tool Division, Rockwell Manufacturing Company, improved precision and operating safety features found in a low priced 17-in., drilling machine for the school shop. Available in a variety of models, the new tool is suitable for both

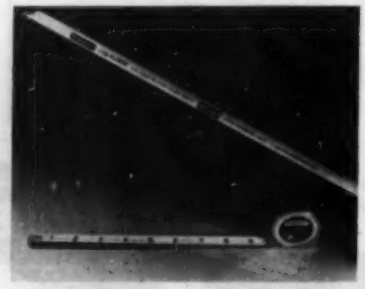
Delta 17-inch Drill Press

wood and metalworking, and has a nominal capacity of 5/8-in. diameter holes in steel, ¾-in. in cast iron. It is the first drill press to provide an internal depth stop with long spindle travel — five inches. This internal stop mechanism provides positive control of pinion shaft rotation and eliminates need for the conventional external stop rod with hard-to-adjust stop nuts. It also eliminates quill deflection at the bottom of the stroke. The internal stop mechanism is easily set with one hand in seconds, consistently repeats to the same depth and stays locked. The depth-gauge can be set from zero, regardless of height of the work, giving a direct reading as the drill penetrates. Many other outstanding features are incorporated. The tool is available in hand or power feed models.

**(For further details encircle index code 0902)**

## steel tape rule

From Stanley Tools, a new type of steel tape rule — Life Guard yellow blade, clad in Mylar — makes possible superior legibility that lasts. Laboratory tests point to the high resistance of this blade to abrasion. Mylar is the Du Pont trademark for its polyester film. The film completely covers both sides of the blade causing it to be unaffected by most solvents, alkalies, and acids. This property will prove of real value to tape rule users,



Life Guard Steel Tape Rule

painters, mechanics, technicians, maintenance men, builders, and homeowners. This newly developed rule has black-on-yellow blade markings, and is offered in 6-, 8-, 10-, and 12-ft. lengths with half-inch width blades, and the ¾ inch width in 10- and 12-ft. lengths to provide the greatest rigidity for extended measuring. Available in newly styled cases, other features include a Tru-Reading mouth, a Tru-Zero hook, foot and inch markings, and stud markings.

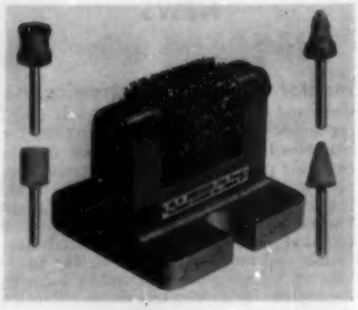
Another line of Pull-Push white blade tape rules with superior blade action in newly styled cases is also announced by Stanley.

New "Fits-All" Mylar replacement blades for Stanley and other tape rules are also ready for market.

**(For further details encircle index code 0903)**

## grinding wheel dresser

From Desmond-Stephan Mfg. Company, a new grinding wheel dresser to restore the shape and grinding action of worn, loaded and out of shape abrasive mounted points. Weighing only 2½ lb., the dresser base 3 by 3¼ in., permits bolting or screwing to bench. The revolving mounted point is held against the thin gauge star type cutters for a few seconds until the original shape of the mounted point is restored. In the



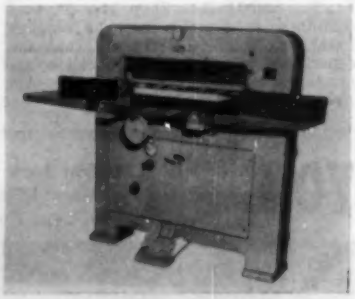
Grinding Wheel Dresser

photograph, the worn and out of shape mounted points at the top have been dressed to their original shape as shown at the bottom.

**(For further details encircle index code 0904)**

## power paper cutter

From The Challenge Machinery Company, a new 30½-in. Power Paper Cutter of particular interest to schools with advanced graphic arts courses or vocational training in printing. This Challenge Champion, Model 305MB handles piles of paper up to 30½



Power Paper Cutter

inches wide and 3½ inches deep, and has outstanding operating features as two-hand, push-button operated safety controls, foot-controlled power clamping, and other operating features of larger shop equipment.

**(For further details encircle index code 0905)**

## combination belt and disk sanders

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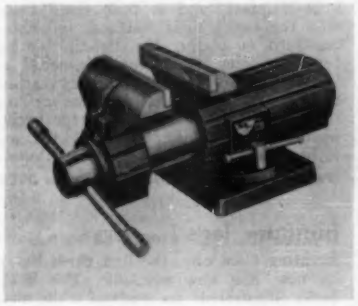
**(For further details encircle index code 0906)**

## new series of mechanics vises

From Milwaukee Tool & Equipment Company, the new mechanics vises are ruggedly designed, machined, and assembled like machinist vises. Features include mod-



Mechanics Vise

ern, rugged design; full 160-deg. swivel; protected factory-lubricated screw; hardened serrated tool steel replaceable jaws; tough, iron-fisted malleable iron casting; available in three sizes — model 865 will offer 5-in. jaw width; model 864, 4-in.; and model 863 offers 3½ in. jaw width. Vises are designed for use in service stations, garages, repair centers, and for the homeowner.

**(For further details encircle index code 0907)**

## sheet metal machines

From American Pullmax Co., the new model, P-2, small-size machine, compact, yet has the 5/32-in. capacity of the large machine, and is capable of doing all 12 standard Pullmax operations. The P-2 is welded box

Model P-2 Sheet Metal Machine

frame construction with mechanism operating in an oil bath. It will do straight, circle, irregular, inside and slot cutting, as well as beading, edge bending, dishing, flanging, joggling and louver cutting. Many sheet metal projects can be done on this machine. Literature and a 16mm.

(Continued on next page)

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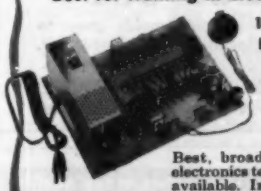

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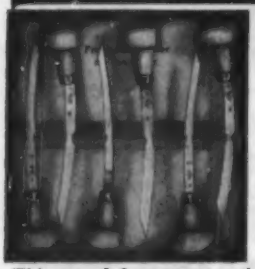

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## SHOP EQUIPMENT NEWS

(Continued from previous page)

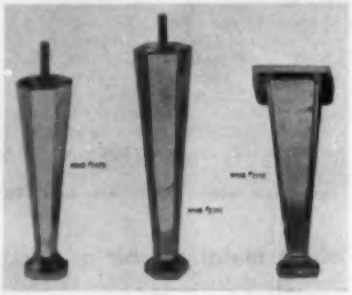
sound film on the operation of Pullmax machines is available by writing.

**(For further details encircle index code 0908)**

**low-cost method of setting anchors** From Skil Corporation, a unique flat-tip carbide bit that provides the fastest, lowest cost method of setting anchors and expansion shields with an electric hammer. This new bit drills holes with virtually flat (160 deg.) bottoms for secure setting of any self-drilling anchors and expansion shields. The new method consists of drilling holes to a pre-set depth with Skil flat-tip carbide bits mounted in the Model 726 Roto-Hammer, and is four times faster than the conventional method and about one-third as costly. The flat-tip bit has unusually long life because of special alloy steel shank and high quality carbide tip. Four sizes of bits, all eight inches long, are available for drilling holes for anchor with bolt sizes ¼ in., 5/16 in., 3/8 in., and ½ in. Available now from Skil distributors.

**(For further details encircle index code 0909)**

**furniture legs** From Wilkenson Manufacturing Company, the first three legs of its new line now available. The WMB Series (illustrated) are made of white metal and electroplated by Wilkenson in a variety of finishes. Standard finishes include



WMB Series of Furniture Legs

Satin Brass, Satin Pewter, Satin Copper, and Satin Chrome, produced with a high polish if desired. Special finishes will be supplied according to specifications. The WMB Series consists of WMB 2100, an octagonal white metal leg 6 in. high with a standard ¼ or 5/16-in. stud; the WMB 2101, 7 in. high with six sides; and the WMB 2102, a four-sided leg with beveled corners, flange molded in one piece with leg. It stands 6 in. high. Wilkenson finishes are electroplated (sprayed, on request) and last indefinitely without chipping, staining, or tarnishing under most climatic conditions. For hot humid areas, aluminum is recommended.

**(For further details encircle index code 0910)**

**glue and floor grip** From The Borden Chemical Company, Elmer's Epoxy Glue and Elmer's Floor Grip, the glue available in a two-part kit consisting of resin and hardener, each in metal squeeze tubes on a blister card, including application instructions, a strong, clear, waterproof adhesive for a wide range of uses; and the floor grip—a synthetic latex rug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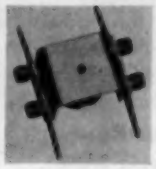

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**(For further details encircle index code 0911)**

## stereo changer/player

From Electronic Instrument Co., Inc., model 1007 stereo changer and player with twin stylus stereo cartridge. This 4-speed precision automatic record changer for 10 records *and* automatic and manual single-record player has: dual RC magnetic input adapter for ultra-smooth response; cartridge easily snapped in and out of tonearm with in-

New Stereo Changer Player

stantly replaceable twin stylus (factory preadjusted stylus force of 4½ grams for low record wear without groove flutter distortion occurring universally at lower forces). Smooth, low distortion, stereo crystal cartridge (absolutely moisture-proof) has been designed integrally with the tone arm to eliminate mid-range resonances.

**(For further details encircle index code 0912)**

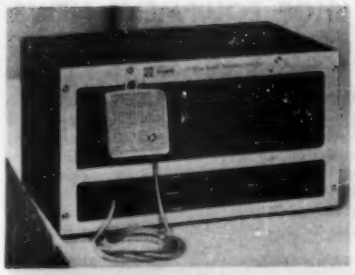
## combination saw blades

From Skil Corporation, a low cost hard tooth combination saw blade with specially hardened teeth. Entire blade thickness is hardened, and the blade's protective black finish minimizes rust, the cutting edge is ideal for tempered laminates, exterior plywoods, and other materials that dull regular blades rapidly. Hard tooth combination saw blades with diamond arbors are available in 6½, 7¼, and 8¼-in. sizes for Skilsaw models. Round arbor hard tooth blades for other makes of portable and table saws are available in sizes from 4¾ to 8¼ in. Round arbor sizes are ½ in., for 4¼ in., 5 in., and 5½ in., diameter blades, and ⅝-in. for blades of 6½, 7¼, and 8¼ in. diameter. The 4¼-in. blade is a novelty tooth combination type and the 5½-in. blade is a chisel tooth combination blade. Both have the hard tooth feature.

**(For further details encircle index code 0913)**

## knight-kit model transceiver kit

From Allied Radio Corporation the new Knight-Kit Model C-11 Citizens Band Transceiver Kit, for two-way communications use. Consisting of a super-regenera-



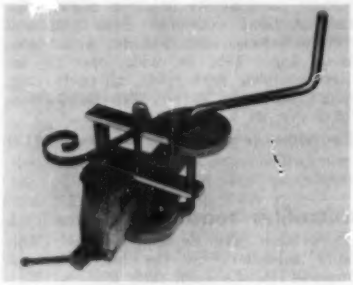
Knight-Kit Model Transceiver Kit

tive receiver and 5-watt transmitter combined into a single unit, the C-11 transceiver has a variety of uses. For stationary or mobile applications, it can be installed on desks, in a car, or even in a boat. Designed to provide short-distance two-way communication on the 11-meter Class D Citizens Band, operation of the C-11 requires a license readily obtainable from the FCC without an examination. Measuring 6 by 10 by 8 in., it is supplied with one crystal (preference of crystal for any one of the 23 frequency channels tuneable by the receiver section may be specified by the buyer), microphone, all parts, wire, and solder.

**(For further details encircle index code 0914)**

## scroll bender

From Hossfeld Manufacturing Company, a new hand-operated scroll bender designed to be held in a bench vise. A sturdy iron frame, pin and roller allow the operator to bend metal man-



Hossfeld Scroll Bender

ually with little effort. No other tools are needed. The set includes three dies for forming 2½-in., 4-in., 5-in., 6½-in., and 8-in. diameter scrolls. All three dies can also be used in the standard Hossfeld benders.

**(For further details encircle index code 0915)**

## new line of C-clamps

From Wilton Tool Manufacturing Company, Inc., full-closing C Clamps in sizes up to 12 inches, six clamps in the series with capacities ranging from 0–3 inches in the smallest clamp, to 0–12 inches in the largest. Minimum proof test varies from 2000 pounds to 4200 pounds. With frames of top grade malleable iron and the Acme thread screws, all sizes have the exclusive Perma-Pad, the swivel guaranteed by Wilton never to come off.

**(For further details encircle index code 0916)**

(Continued on next page)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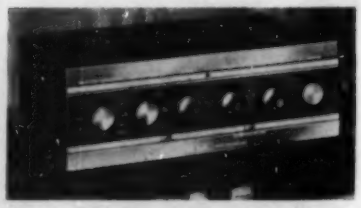
# SHOP EQUIPMENT NEWS

(Continued from previous page)

**allied knight-kit** From Allied Radio Corporation, the Knight-Kit Deluxe Stereo Preamplifier Kit, designed for easy construction, to serve as a highly flexible control center for any stereo or monophonic high fidelity system. Dual-concentric, clutch-type controls permit convenient, precise adjustment of bass, treble, and level.



The Knight-Kit Deluxe Stereo Preamplifier Kit

The volume and tone of each channel may be regulated separately or simultaneously. Though designed primarily for stereo use, the unit's five positions of record equalization assure proper tonal characteristics from any monophonic record — a feature sure to be appreciated by those having large libraries of monophonic records. Additional features include: dual-gauged, continuously variable loudness controls, LC-type scratch filter to eliminate scratch without affecting mid-range frequencies; rumble filter and cathode follower outputs. Unit has separate tape recorder outputs which function independently of tone and volume controls. Available in desert-beige and anodized sand-gold escutcheon and cordovan gray case, 4⅛ in. high (plus ⅝-in. legs), 13¼ in. wide, and 7½ in. deep, complete with tubes, all parts, case, solder, wire, and step-by-step instructions. Stock No. 83 YX 768.

**(For further details encircle index code 0917)**

**microfilm reader** From Recordak Corporation, the Eastman Kodak Company subsidiary in the microfilm and business systems field, their low-cost Recordak Model 310 Microfilm Reader designed for use with unperforated 16mm. microfilm in 100-ft. rolls. The new lightweight unit (only 23 lb.) features a conveniently located film advance lever on the side of the machine. Image area is

Recordak Model 310 Microfilm Reader

9 by 12 in., and the overall height of the machine is under 20 in. Available in reduction ratios of 20:1, 24:1, and 40:1, the 310 is styled in two-tone green with viewing screen tinted a soft green to ease operator eye fatigue.

A basically similar reader, the Model 310-A, featuring 270-deg. rotation was designed for installations where the duo method of microfilming is in use.

**(For further details encircle index code 0918)**

**round and square tubing** From Wilkenson Manufacturing Company, tubing available within twenty-four hours from

Wilkenson Tubing

date of order to service manufacturers whose space facilities prevent excessive stocking of tubing. Wilkenson offers round tubing in these standard diameters: ½ in., ¾ in., 1⅛ in., 1¼ in., 1⅜ in., 1½ in., and 1¾ in. Square tubing is available in ⅝ in., ¾ in., 1 in., 1½ in., and 2 in., to be had in any amount as needed, cut to any length desired, in satin or polished finishes: brass, copper, pewter, or chrome; and upon request, Old English, antique, or gold-plated finish in addition to particular finish that is specified. Wilkenson also has a variety of Epoxy finishes.

**(For further details encircle index code 0919)**

**custom fabricated extension plate** From Brett-Guard Company, the continuously adjustable side extension plate for double arbor (floating arbor) saw. Application of the Brett-Guard Safety Guard and Saw Production Tool to saws equipped with double arbors as well as

Custom Fabricated Extension Plate

single arbors is accomplished by the use of a custom fabricated, special extension plate. This plate is equipped with a sub-base for the Guard, tongued and grooved into the special extension plate. Also the sub-base is provided with lock screws which permit the sub-base to be located in any position parallel to the saw arbor as the arbor line is changed by changing the position of the blade, and firmly locked in that position. The purpose of this custom fabricated extension plate is to provide quick and easy back-and-forth adjustment of the entire Brett-Guard in order to accommodate the back-and-forth movement of the arbor as the saw is lowered or raised to different positions.

**(For further details encircle index code 0920)**

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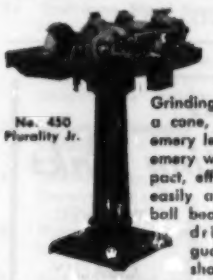

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**safety drill** From Millers Falls Company an industry first in the new No. 1144 double-insulated ¼-in. Safe-T-Drill with nylon housing and insulated chuck, offering greatly increased safety, high strength, and a saving in weight. As a first line of protection against electric shock, the Safe-T-Drill is equipped with a Millers Falls

"Shockproof" Nylon Safe-T-Drill

built motor "surge-tested" at ultra high voltages to make sure there are no flaws or weaknesses in the internal insulation. Also, double protection provided by the drill's insulated chuck spindle and nylon housing. In addition, this tool serves as the power unit for a complete 14-tool power workshop with a motor rated at a full 2.7 amperes. It drives attachments such as the 5½-in. circular saw, hedge trimmer and finish sander. Other units include a portable and bench saber saw, bench grinder, bench sander, and many more. Several of these attachments incorporate a new Millers Falls on-and-off-in-seconds Quik-Change feature to facilitate setting up different power tools in a hurry. The housing of Du Pont Zytel 31 produces exceptional toughness and durability.

**(For further details encircle index code 0921)**

## Descriptive Material . . .

*From General Scientific Equipment Company,* Bulletin No. 138, illustrating and describing a line of gas pressure manometers, oil flow graduates, sling psychrometers, air velocity meters, filter gauges, recording thermometers, carbon monoxide detectors, kits for testing gas heating equipment, $CO^2$ indicators, smoke testers, draft gauges, flue gas thermometers, and pressure point testers.

**(For further details encircle index code 0922)**

(Continued on next page)


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(Continued from previous page)

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**(For further details encircle index code 0923)**

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**(For further details encircle index code 0924)**

*From Angle Steel Incorporated,* their 16-page, fully illustrated two-color catalog of school shop equipment, offering complete descriptions of their line of student shop benches in one-, two-, or four-student styles, shop and cabinet lockers, workbenches for the general shop or for welding; also drafting and drawing tables and other equipment including stools, cabinet benches, desks and planning and layout tables. Included are various accessories, racks, stock carts, etc., for the school shop. Catalog No. 6000.
**(For further details encircle index code 0925)**

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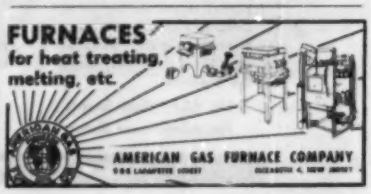

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## INDEX TO SHOP EQUIPMENT

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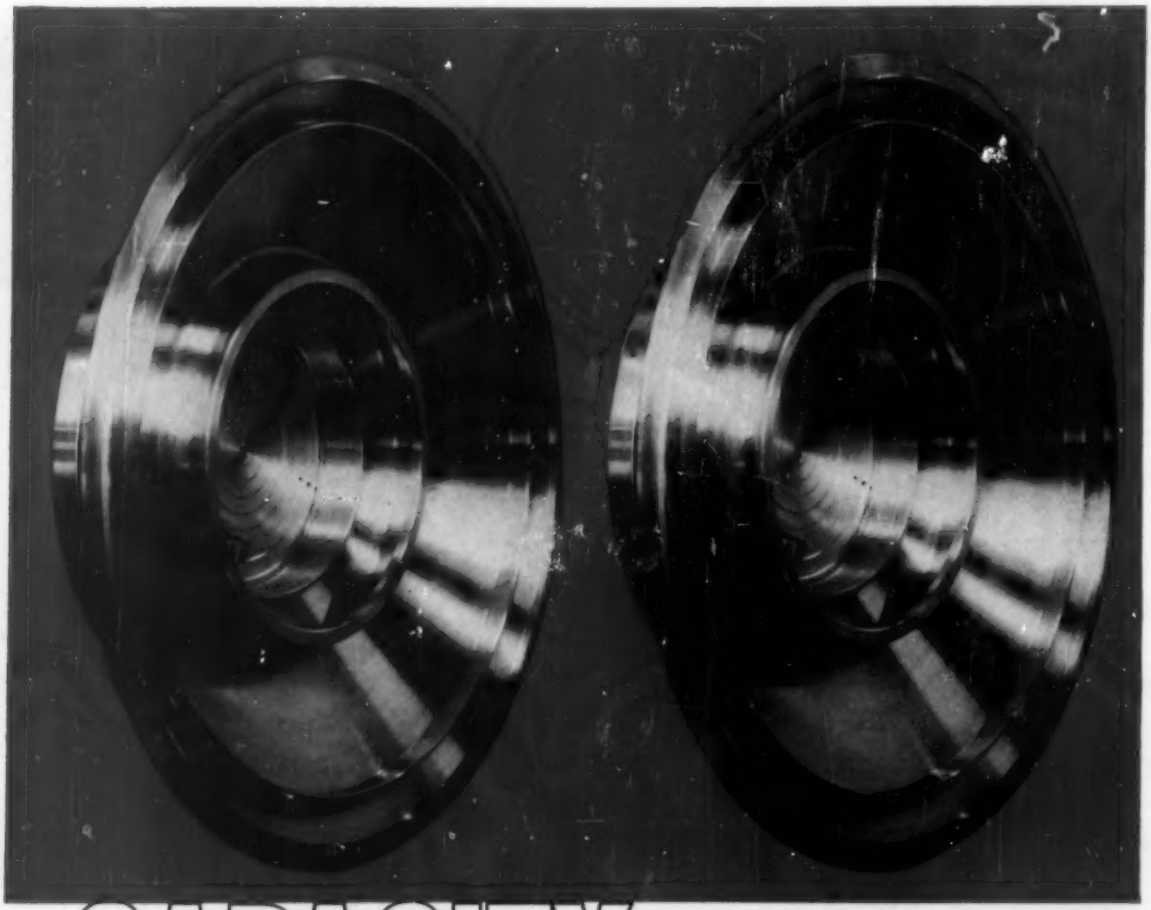

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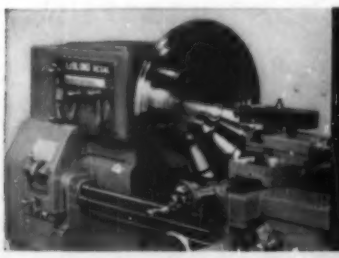

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